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America's Belated Recognition of Oliver Heaviside

WE PUBLISH in another column an announcement that the board of directors of the American Institute of Electrical Engineers has elected Oliver Heaviside an honorary member. Thus another great name is added to the small list of honorary members of the Institute, which comprises André Blondel, S. Z. de Ferranti, C. E. L. Brown and Guglielmo Marconi. It is, indeed, a belated tribute which America thus pays to the powerful English mathematical physicist, whose brilliant work on electromagnetic theory laid the foundation upon which the great superstructure of long-distance telephony has since been reared. When this generation bears in mind that as early as 1887 Oliver Heaviside demonstrated theoretically, and then urged practically, the advantage of inductance in telephone circuits; when it has further considered that the British Post Office Department, then under Sir William Preece, failed completely to understand his theories, so much so that Sir William Preece suggested for a transatlantic telephone cable a cable in which the electrostatic capacity was increased, it is little wonder that it has taken some time to bring about a clear recognition of Heaviside's fundamental principles underlying the propagation of electric impulses along wires and cables.

Unceasingly, in the teeth of a gale of "scienticulist" ignorance and prejudice, this great mathematician developed his theories and urged experimental work along the lines laid down by him, aiming at an increase of the inductance per unit length of the cable or conductor. In a series of brilliant articles published in 1893 in the London *Electrician* he suggested having "large distributed inductance together with inductance in isolated lumps. This means the insertion of inductance coils at intervals in the main circuit. . . . The electrical difficulty here is that inductance coils have resistance as well, and if this be too great, the remedy is worse than the disease. . . . This means using coils of low resistance and the largest possible time constants."

Twenty-five years have passed. Under the direction of Col. J. J. Carty, telephone engineers of this country have demonstrated the truth and the applicability of Oliver Heaviside's scientific reasoning. Great is truth, though it may be slow in prevailing!

Not alone, however great this work has been, can it be viewed as Heaviside's life work. Besides numerous contributions to the science of mathematics of utmost and revolutionary importance, there are the Heaviside units, called the "rational" units; there is the "rational" current element used throughout his work by Sir Joseph John Thomson; there are the fundamental equations of the motion of an electrically charged body, with all the ramifications of mathematical and scientific work, which has culminated in the theory of the electron, and inseparably connected with Heaviside's name is the "distortionless circuit" and its beautiful theory. A busy age may plead preoccupation in extenuation of its failure to give earlier official recognition. So many are the subjects touched upon in Heaviside's writings, so absorbing and stimulative are these contributions to electrical science, that they have been an inexhaustible source from which lesser men have drawn material for interesting and instructive papers. The theory of the distortionless circuit, the building up of the steady state from a conception of direct and reflected waves, the use of operators—all these are but a few of the contributions made more than a quarter of a century ago, and they are cited at random from the wealth of Heaviside's papers. May this recognition of one of the greatest mathematical physicists the world has ever known convey to Great Britain and her men of science another message from America that in realization of each other's strength must lie the basis of their enduring greatness and invincibility.

Protect the Credit of the Utilities

IT WAS not necessary under normal conditions to give serious concern to the subject of credit of well-managed electric utilities. They had good credit. It is highly necessary to give most careful attention to this vital question under the war conditions of to-day. Herbert A. Wagner, in the suggestive article published in this issue, discusses critically the vital problem of maintenance of sound credit. It cannot safely be ignored or left to haphazard decision. This is a matter which is intimately connected with the operation of war industries at war-time speed and with satisfactory service to the general public. It is not the part of wisdom to let these properties be subject to the economic burdens of war and at the same time to withhold relief from them through larger revenue where higher rates are required.

Recognizing that the paramount obligation of the utility is to the public which it serves, Mr. Wagner discusses various other considerations which should be kept in mind. These are, first, the positive obligation to bondholders, who may throw the property into confusion, endangering the equity of shareholders, if their interest is not met; second, the obligation to shareholders, which is only slightly less than the obliga-

tion to bondholders, for the public utility stock certificate with state rigid regulation represents investment and limited return, not speculation and a fair chance of big profits; and, third, most important of all to the large body of consumers, the urgent importance of meeting the need for ever-increasing service in a growing community. To comply with the demand for service, which is a very real and crying demand in these times, you have to provide plant. To buy plant takes money. And one cannot get investment money at low rates from the bankers unless credit is good, unless earnings show ability to pay, unless the record of the past is unequivocal payment of obligations and sustained earning power.

Only the keen appreciation of the crisis which lies just on the border line of sustained credit or damaged credit justifies the utilities in bringing their problems to public attention when the nation is at war. Ordinary trials they would face without complaint. But they cannot afford now to lose the ability to cope uncrippled with whatever the future holds. They cannot dissipate strength in struggle when it is imperatively needed for efficient operation. They can weather a storm if clear, smooth seas lie ahead. It is plainly the hour when the utilities have the right to insist that all of the obligation is not resting upon them. Some of it belongs to the other side. Maintained credit will keep them in the best condition to give the service which will help to win the war. The utilities ask in confidence that their business be set and kept on a self-sustaining basis, so that irrespective of government aid in financing they may make a good showing and have a reasonable surplus.

Seriousness of the Coal Situation

THE only certain feature about the coal situation is its seriousness. This unfortunately does not appear to grow less with time. Indications are that fuel will be as hard to get as ever and with the coal zoning system many utilities will have in addition to content themselves with inferior coal. Prudent managers, therefore, will lay in as large a supply of fuel as they can obtain before railroad service becomes any worse, and operators will adapt their furnaces to the grade of coal allotted them. This is sensible as well as patriotic. So far as public utilities are concerned the Fuel Administration is doing its utmost to provide for their wants, but the best laid plans often go awry owing to circumstances beyond the control of the planner. The Fuel Administration is not the Railroad Administration, and thereon hangs a tale. Just as long as co-operation between administrations and co-ordination of various governmental activities are lacking, to that extent there will be confusion and inefficiency. Coal at the mines is of no service to a utility. It can only be used when in the bunkers of power houses, and to put it there cars are necessary. If the Railroad Administration does not provide the cars, the Fuel Administration is helpless. The zoning system of the Fuel Administration was devised primarily to help the Railroad Administration, but no one-sided co-operation is ever very effective. The railroads, of course, are deluged with freight, and some day there may be a freer movement of low-grade freight, which includes coal. Until that day arrives, however, the coal situation will continue to be serious. The safest way to provide against freight contingencies is to get all the coal obtainable and store the surplus. In such a plan the co-operation of the Fuel Administration is assured.

Additions to the Commonwealth Edison Plant

NO BETTER evidence of the difficulty of keeping pace with the demand of a great and rapidly growing city can be found than in the description of some of the new work at the Northwest station of the Commonwealth Edison Company which we publish this week. The first plant contained two 20,000-kw. units, to which have now been added three 30,000-kw. turbo-generators and one of 35,000 kw., the last-named for 25-cycle operation like the original plant. When in full operation the station will be able to furnish 85,000 kw. at 25 cycles and 80,000 kw. at 60 cycles. To provide for this immense output corresponding changes have been necessary in the boiler room. Each of the first two machines of 20,000 kw. was fitted with ten boilers per unit. The last generators, in spite of their greatly increased rating, have only five double boilers each.

This change is an impressive demonstration of the tendency toward getting boiler units somewhere nearly commensurate with the generator capacity. Whether the time will ever come when it will be the practice to install one boiler unit per generator is another matter. Probably not, since boilers require overhauling on account of the nature of their service, and it is desirable to have the boiler capacity sufficiently subdivided to permit one section to be taken out of service without too great inconvenience.

The additions to the plant have also involved a general change from steam to electric drive for all the auxiliaries, a change thoroughly in keeping with the general trend of practice for obtaining higher efficiency and greater convenience. All the new units are equipped with direct-connected exciters, and the circuits are so connected that each unit can be fully controlled from its own particular panel. They are all, too, equipped with control relays which are somewhat unusual in the thoroughness of the operations conducted by them. When tripped they act in succession to open the main generator switches, the generator field switch, the generator neutral switch, and the ventilating-fan switch in the case of the machines which have artificial ventilation.

Exploring coils installed in the generators are connected to temperature indicators in the operating gallery, and similar coils in the air intakes of the machines give continuous indications of the temperatures reached in operation. The whole switching equipment of the new plant is installed in the more recent portion of the switch house, which contains a basement for cables, high-tension buses on the first floor, oil and disconnecting switches on the second floor and the oil-switch mechanism on the third floor. Interesting details regarding the arrangement of the switchboard connections and apparatus in the plant are included. Our readers will find in the diagrams a wealth of information regarding the complete equipment of this very modern and highly organized plant.

Taking Proper Care of Reactors

ALTERNATING-CURRENT stations grow bigger and bigger, and the importance of reactors to serve as protection against short circuits becomes greater and greater. In the earlier days of alternating-current service every effort was made to improve generators in the direction of lowered reactance, so as to obtain good inherent regulation to facilitate the keeping up of uniform voltage. The first alternators were extremely unsatisfactory in this respect, but as bigger machines came into use it was found that a moderately high reactance was very desirable to avert trouble from short circuits, particularly where machines were operated in parallel. Later it was found advisable to put this reactance in part at least outside the machine, chiefly for mechanical reasons. The average engineer has a very meager idea of the tremendous forces exerted by reactors when big currents arising from a short circuit occur. The installation of reactors transfers the major part of the troubles from the generator to the reactor, hence in the design and installation of these much care has proved to be necessary.

M. E. Skinner's paper on this subject throws a vivid light on the electrodynamic problems of reactor installation. The reactors in practical use are always without iron cores. They are akin to the primary circuit of a coreless transformer adapted to carry very great currents, and usually take the form of coils of bare wire with the turns supported on fireproof and non-magnetic material. They are too big to immerse conveniently in oil tanks, so reliance is placed on air as a dielectric. The temperatures reached under short-circuit condition may be very high. Ordinary insulating materials would be of little service even if one attempted to employ them.

Owing to the fact that the reactor coil is without a core and its magnetic field very widely distributed, particular pains must be taken to keep it away from closed metallic circuits of every kind to prevent loss of energy and even possible overheating. It is found in practice, for example, that beams, pipes and even expanded metal may be very considerably heated by acting as secondaries to the reactor coils, so that in installing reactors it is necessary to pay close attention to the surroundings. Finally, the magnetic stresses may result in drawing loose magnetic bodies into the coils and short-circuiting or injuring some of the turns. For the same reason the forces between two adjacent reactors may become high enough to cause mechanical trouble to supports in case of short circuit unless fairly liberal spacing is adopted.

Overcoming the Difficulties of Long-Span Construction

IT IS to the great transmission networks of the Pacific Coast that engineers continually look for important suggestions in power transmission. The art began there, and the Coast has continually been in the front line of progress. In particular the Pacific plants have had to deal with topographical conditions which have made their pole lines of very diversified and interesting character, especially since long spans have been used far more freely than in most other parts of the country. Not only have there been various sensational feats in spanning navigable waters but there has been a free use of uncommonly long spans in the more ordinary classes of pole construction. The difficulties which have been encountered in such work are of a rather special character, since the length of the span increases the possibility of conductors swinging into contact, a contingency quite negligible under ordinary circumstances. The stresses on the insulators and their supporting structures are increased too, and there is of course the usual rise in the stress of the conductors.

To meet these requirements it is usual to space the conductors more widely than has been the practice elsewhere, to use relatively heavy conductors, and sometimes to provide intermediate spacing devices. Just which one of these devices is most effective has to be determined in accordance with the local conditions. In some of the longer spans stranded-steel cable has been used successfully, in others composite wire, and sometimes even copper carried on a messenger cable.

For protection against the strains produced by changes of temperature at least one very interesting development has been made. The strain insulator group is attached at the tower side, not directly, but to a cable passing over pulleys, and thence to heavy concrete weights inside the tower, so that the connection is a flexible one ready to yield to the necessary degree when extra strains are imposed on the cable, and so to keep the tensions uniform. Considerable progress has been made, too, by dividing the strain of long spans between groups of insulators installed in parallel, with equalizing yokes when of the disk type.

When one realizes that in these Coast systems spans from 1000 ft. to 2500 ft. (304.8 m. to 762 m.) in length are fairly common the necessity of special engineering becomes altogether obvious. For this class of work stranded steel is being freely used regardless of voltage. A study of the suggestions contained in this particular article ought to result in considerable saving for many Eastern lines.

The Coming Issues

DECREASED net profits due to the rapidly mounting cost of operation have forced central stations to look more than ever to methods of improving economy. Among articles which will be published from time to time to show how the situation can be faced one will be presented soon giving the capitalized value of the yearly saving which can be realized from higher steam pressures. Various loads, coal prices and rates of capitalization are taken into consideration. Features of additions to the Northwest station which are touched on in this week's issue will be further noticed next week, special attention being given to the control of auxiliary motors in the plant. A precision method of measuring alternating currents which requires relatively simple apparatus and by which all disturbing factors are eliminated or minimized so that they can be disregarded will be explained, and results of tests to show the accuracy of the method will be given. Value of flywheels for woodworking machines and methods of economizing in copper for transmission and distribution will also be discussed. The effects of daylight saving on central-station load curves and income will also be treated in articles from time to time.

The Credit of Public Utilities

Commission Regulation with Limited Rate of Return Should Be Counterbalanced by Elimination of Risk to Investors—Additional Capital in Large Amounts Must Be Attracted

BY HERBERT A. WAGNER

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IN THESE times, when the energy of the entire nation is being mobilized with the one object in view of winning the war, the financial resources of the country are being taxed to the utmost. Our public utilities are being called upon for more service than ever before, while at the same time their operating expenses are being greatly increased and their means of obtaining the additional capital required are being restricted in every way. It is most essential, from the standpoint of national efficiency, that these corporations should be permitted to make such additions to their charges for service as will enable them to maintain their credit.

The credit of a public utility, like that of any corporation or individual, depends upon its ability to meet its obligations. The obligations of a public utility are threefold and of equal importance to its credit—first, its obligation to the public; second, its obligation to its bondholders, noteholders and other creditors; third, its obligation to its shareholders.

OBLIGATIONS OF THE PUBLIC UTILITY

Its obligation to the public includes good service, adequate service and prompt provisions for additional facilities to furnish increased service as demanded. Its obligation to its bondholders and noteholders includes not only the payment of interest but the maintenance of the value of its property and a reasonable equity in value above the bond and note issues. The strongest evidence of the maintenance of the required equity is in the maintenance of a fair margin in earnings above its interest obligations, and the best proof of the maintenance of such margin in earnings is the actual payment of dividends on the capital stock. On the other hand, a failure to maintain the usual dividend rate would be a direct admission of inability to maintain a normal margin.

The utility corporation's obligation to its shareholders includes not only the maintenance of the confidence of existing shareholders but also the maintenance of the confidence of the investing public, to whom the utility must apply time and again and with increasing frequency for a substantial part of the money required for expanding business and in ever-increasing amounts. No corporation can do business entirely upon borrowed capital. A substantial part of its capital must be furnished by its stockholders, and the ratio between borrowed capital and stock issued must be maintained as greater amounts of capital are required for the growth of the business.

The laws in most states prohibit the issue of public utility stock at less than par. Many issues have been put out at par or over, under the regulations and approval of public service commissions.

It is evident that, as future stock issues are an absolutely necessary part of future financing, it will be impossible to put out additional shares at par if the market price of outstanding shares is not maintained at par or over. Manifestly the only practical course for public service commissions to pursue is to do all within their power, under the law, through the adjustment of rates for service, to maintain, in so far as may be possible, by the payment of dividends, the market value of shares issued under their approval, at prices not less than the price of original issue.

THE UTILITY CANNOT STAND STILL

The public utility is in an altogether different position from all other industrial and commercial undertakings. It cannot stand still and mark time at its will nor merely maintain its existing business. It is forced continually to expand its facilities at the demand of the public, and at an enormous rate of growth, particularly in present times. The annual new capital requirements are many times the total net income of such concerns and, by law, the earnings cannot be used to finance the growth, nor can money be diverted for this purpose from the payment of dividends.

The element of risk in the investment in public utility shares should be practically eliminated. Ordinary business enterprises succeed or fail according to their character and the demands for their products, and wise investors continue to invest only in those which appear to offer the best prospects of success. The public utility, on the other hand, cannot be permitted to rise or fall with fluctuations or changes in the opinion of the investing public in regard to its chances of success or the risk involved. Public utilities must continue in business and must continue to expand, and consequently must readily secure additional money. This involves the absolute necessity for financial success and substantial profits.

There is nothing of greater practical importance in assuring good and adequate service to the public than the maintenance of regularity in the dividend rate paid by a utility to its shareholders. In the past it has been a practice to regard shareholders as standing in substantially the relationship of partners in a business. They were supposed to be familiar with the status and fluctuations of the business and were expected to share in its ups and downs. But the corporation which has shareholders who are not active in the business or familiar with it is in a different situation, and this applies with particular force to the great public utility corporations that number their shareholders in the thousands and tens of thousands.

The great majority of the shareholders in such corporations have only the barest information as to the manner in which the business is handled and as to the results that are being achieved, and are not sufficiently familiar with the business or sufficiently interested in it to absorb more detailed information even if it were

given to them. They regard their ownership of public utility stock purely as an investment of capital that will bring them an income. They buy such stock with much the same purpose as they would have in buying a real estate mortgage, the only purpose being that of securing a dependable income with a chance of profit. The object that is actually in their minds in making the purchase is not a partnership interest in a going enterprise but the acquisition of certain certificates of stock which at regular intervals will bring them dividend checks.

To shareholders of this type regularity in their dividend returns is of the greatest importance. They count upon these returns as a fixed portion of their income. Indeed, in thousands of instances the living expenses of dependents are provided out of these dividends. In this present war time these dividends are being already substantially reduced by federal income taxes and made to bear their part of the burden imposed by the war. Further than this, the purchasing power of all money has greatly decreased under existing conditions, which in itself is equivalent to a decrease in dividend rate.

The desirability of maintaining regularity of dividend rates rests not merely upon the duty of the corporation to its shareholders but also upon a substantial advantage for the corporation itself, by reason of the fact that shares which yield regular dividends are in far greater demand by owners of capital who are not engaged in active business or who are investing their hard-won savings than those shares which are paying irregular dividends, however large these latter may sometimes be.

Out of two stock issues, otherwise equivalent, one of which is paying a permanent dividend rate year after year, and the other of which is paying dividends irregularly but averaging at least as high as the regular payer, the former issue will always sell at a substantially higher price. For this reason the corporation which has succeeded over a period of years in maintaining a record of dividend stability, and which has not changed and is not likely to change its dividend, except to raise it to a permanently higher level, enjoys the benefit of a credit and of a consequent demand for its securities which is worth an enormous amount to the corporation and to the public which it serves.

By commission regulation public utilities have been deprived of the possibility enjoyed by all other industries of taking advantage of the law of supply and demand for fixing prices and maintaining profits. Their ability to maintain profits is no longer dependent primarily upon the skill and foresight of the management, but is limited to what may be laid down from time to time as a fair rate of return on the capital invested, nor is this rate of return even assured by more than implication and the moral responsibility and self-interest of the community. The ultimate responsibility lies with the public service commission, and it has been confidently expected that limitation in the amount of profits which may be earned on the investment of public utilities by such regulation would be offset and counterbalanced by the practical elimination of risk to investors and shareholders in such corporations.

By this it is not to be understood that such regulation should or could eliminate the risk incident to inefficient management (although this, to a large extent, is also under the control of the commission), nor the risk incident to depressed or subnormal general business conditions. The risk that can and should be eliminated, however, is that due to insufficient rates for service to provide for operating expenses, fixed charges and dividends; or, in other words, for the maintenance of the normally prosperous financial condition of the corporation in times of normal or expanding business. When operating expenses increase, owing to increasing cost of materials and wages, the rates for service should increase in commensurate degree.

HERBERT A. WAGNER

IS IT TO BE A GAMBLE?

If the purchase of public utility stock is to become a gamble on the part of investors, then the chance of obtaining adequate service must become a gamble on the part of the consumers.

In just so far as the risk of loss in income to the investor is minimized will the risk of inadequate service to the consumer be minimized. Additional capital in large amounts must be attracted to the utility each year to meet the growing demands of the consumer, and in order to attract the capital of the investor a record must be established and maintained for regularity and sufficiency in income-producing dividends which will not only hold the investor but will induce him, under money market conditions existing at the time, to buy more stock when it is offered.

Credit and borrowing power are not necessarily equivalent terms. While it is necessary to have good credit in order to negotiate loans satisfactorily, there are times when it is difficult or next to impossible to borrow money even with good credit. When money is plentiful almost any concern with ordinarily good credit can obtain it. When, however, there is an unusual demand for money, and for more money than there is available, then only extraordinarily good credit will command it.

At the present time the demand of the United States government for money has strained all our resources, and only those public service corporations which can show a far better credit than would be considered necessary in normal times can hope to obtain money, even at the prevailing higher rates of interest. Rates of interest are far higher than in normal times, and those undertakings which need money must not only prove their ability to pay the higher rates of interest demanded but must also show an earning capacity to

provide a higher margin above their fixed interest obligations than in usual times.

DANGERS OF DECLINE IN EARNING POWER

In these times any corporation which must admit its inability to pay its usual rate of dividends will get small consideration in the money market. The banks and trust companies throughout the country must, directly or indirectly, supply such money as the public service companies are able to obtain, and these same financial institutions are interested in one way or another in the shares of such companies, and consequently in the dividends paid. Even where banks or trust companies may not have invested directly in such shares, they are quite generally carrying loans which have been made by borrowers with such shares as collateral. Shrinkage in the value of such securities, particularly when it becomes general, creates a financial situation which not only embarrasses the investing public but the banks themselves. It is no doubt for this reason that John Skelton Williams, Comptroller of the Currency, in his last annual report to Congress, took occasion to call attention to the danger of the situation being brought about by the decline of the earning capacity of public utilities in the following words:

> National and state banks and many thousands of small and large investors have suffered seriously from the decline of the earning capacity of public utility corporations and the consequent shrinkage in the value of their securities, representing investments of many hundred millions of dollars. These losses naturally diminish the power and disposition of the public to respond to the calls of the government for money for war. This danger should arouse, I venture to suggest, the anxiety and stimulate the efforts of the Congress and of every patriotic citizen. A more urgent and pressing peril is forced upon our attention by the obvious fact that we are dependent so largely on the efficiency and strength of these corporations and on our railroads for speed and success in preparing for and prosecuting the war. . . . If they are allowed to sink into inefficiency, much of the important war work will be crippled or paralyzed.
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> The work of war has thrown upon many of these corporations strains which they are unable to endure without prompt help. The costs of their labor and of all material for operation, betterment and upkeep have increased heavily and suddenly. They are required to increase radically and quickly their service and facilities. Industries manufacturing war munitions and materials demand of the public utilities corporations constantly greater supplies of power and light. At the industrial centers car lines are being rushed and overburdened by new armies of workers. The gas companies are called upon for gas for cooking and heating in quantities beyond all normal calculations and far beyond their present capacities. . . .
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> The continued and increasing efficiency of these corporations is important for the successful conduct of the war. This efficiency is not possible with present conditions. Corporations proved by their own figures to be approaching bankruptcy cannot obtain money for improvements or maintenance. On the other hand, banks and citizens suffering severe losses from investments in the securities of these entirely legitimate and once promising enterprises will be discouraged from lending money to the government or deprived of the means to lend.
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> The first and most direct relief to the public utilities corporations can be given by the state public utilities commissions and municipal and local authorities, with the broad-minded co-operation of the people generally, understanding the necessities of war and realizing that the more promptly its burdens are accepted the sooner they will be lifted. It is essential that forbearance and consideration be exercised by the state commissions and municipal authorities, and that the corporations also be permitted to make such additions to their charges for service as will keep in them the breath of solvency, protect their owners against unjust loss and give them a basis of credit on which they may obtain the funds with which to meet the strain put on them by the government's needs. The breaking down of these corporations would be a national calamity.

The public utility corporations in the United States have an aggregate capitalization of more than $10,000,000,000. Their annual operating revenues, combined, amount to more than $500,000,000. The combined funded obligations of these utilities maturing in 1918 approximate $225,000,000. It is estimated that they are carrying, in addition, about $300,000,000 of short-term notes which must be refunded within from one to four years hence. These obligations cannot be met with impaired credit.

NEW JERSEY'S COMMISSION POINTS THE WAY

The attitude taken by the Board of Public Utility Commissioners of New Jersey in granting an increase in gas and electric rates upon the petition of the Public Service Corporation of New Jersey shows a broad and enlightened grasp of the financial situation and of the need of maintaining public confidence and stable security market conditions. This board has clearly pointed the way which all commissions should promptly follow to avert the national danger of which the Comptroller of the Currency has warned the country. In its opinion this board says:

> Although not specifically stated therein, the petition is in effect a prayer for emergency relief on account of the extraordinary increases in the cost of labor and materials entering into the production and distribution of the company's power, arising out of the war. . . .
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> The Board has dealt with this application as one growing out of extraordinary war conditions resulting in abnormally high costs. We have not dealt with this proceeding as we would, under normal conditions, deal with an application to increase rates. . . .
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> It is a matter of common knowledge that wages and the cost of fuel which make up a large part of the production expense of electric light and power companies have greatly increased, and, in fact, that all labor and supplies which must be used in the process of operating such properties and maintaining them in repair have risen greatly in price since the normal pre-war times—in some instances, in the case of supplies, the rise being more than 100 per cent. These added costs must be met. The question now presented, therefore, is whether they may with fairness be met by an increase in rates. . . .
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> We have not dealt with the value of the property in this proceeding. In the existing emergency the determining consideration must be to keep the property in uninterrupted and effective operation. This involves the payment of fixed rentals and charges, without regard to the value of the property, since failure to satisfy such contracted rents and charges would jeopardize uninterrupted operation.
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> If the revenues are not increased to meet these added costs, the moneys available for dividends will be substantially diminished. In the present financial situation the public has a vital interest in maintaining the fund available for dividends on the stock of the company. Without assurance of sufficient earnings at the present time, the company will be unable to attract new capital to finance the extensions that are required to meet war needs. A material decrease in dividends would not only result in preventing the free flow of new capital but would materially depreciate the market value of outstanding securities.
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> This possible shrinkage in the value and marketability of such securities would tend to undermine confidence and render unstable security markets. Such a condition would have direct influence upon the securing of money by the national government for war purposes. The required funds for these purposes must be yielded by operating revenues. In the broad view the public interest requires it.

Special Transmission-Line Problems

How Some Difficulties Peculiar to Supporting Long Spans Have Been Overcome on the Pacific Coast—Use Made of Novel Methods—Details of the Structures That Have Been Employed

METHODS of preventing the ordinary troubles which are liable to arise in connection with moderate-span transmission lines have been discussed quite fully in various articles printed in the ELECTRICAL WORLD. In this article it is the intention to consider some of the more special problems, especially those encountered in supporting long spans, and to point out how they may be solved. Practice on the Pacific Coast is cited in most instances because topographical conditions there require the use of long spans to a greater extent, perhaps, than anywhere else in this country.

In some places where long spans are required—for instance, over rocky country or places cut by deep ravines—it is possible to place the supporting structures on elevated places, so relatively short poles can be used. In other places, however, where large bodies of water must be crossed or where long stretches of ground are level but of such a nature that it is difficult to set poles satisfactorily, additional problems are imposed inasmuch as tall towers may be required.

PROBLEMS PECULIAR TO LONG-SPAN CONSTRUCTION

Regardless of whether tall or short supports have to be used, special problems are encountered which might be only incidental with moderate-length spans. For instance, with long spans there is more of a tendency for the conductors to swing into metallic contact with each other, larger stresses have to be transmitted through the insulators to the supporting structures, excessive strains have to be avoided in the conductors and other similar conditions arise. Provision must also be made to withstand the whipping action of the conductors when they are subjected to gusts of winds and also to prevent failure of the towers in case the long spans break.

The possibility of the conductors swinging together can be avoided or minimized in several ways—by spacing the conductors liberally, by using conductors which are relatively heavy compared with the area exposed to wind pressure, by using intermediate spacing structures, by minimizing the sag, and by artificially weighting the conductors. The first three methods are used most extensively, both singly and collectively.

The sag can be minimized, of course, by employing extra high strength conductors, but this method increases the strain on the towers and makes them more expensive. Providing liberal spacing at the supporting structures also makes the latter more expensive, since longer cross-arms have to be used. Only detailed analysis of each case will determine which method is most economical. Even where suspension insulators could be used, as may be practicable where the adjacent spans are sufficiently long to balance each other, it may be advisable to use pin or strain insulators to prevent conductor deflection, which can occur if suspension insulators are used.

The clearances ordinarily required over rights-of-way do not usually impose so great a problem as those over navigable streams. Where the structures at each end of the long span can be erected on elevated ground the expense and engineering problem of designing and providing mechanically satisfactory towers are considerably reduced, as they can be made relatively short. This cannot be done in many cases, however, and therefore tall towers have to be employed or conductors with very high tensile strength have to be used to permit reducing the sag, or both.

In one case in the Northwest the expense of tall steel structures was avoided by splicing wood poles together

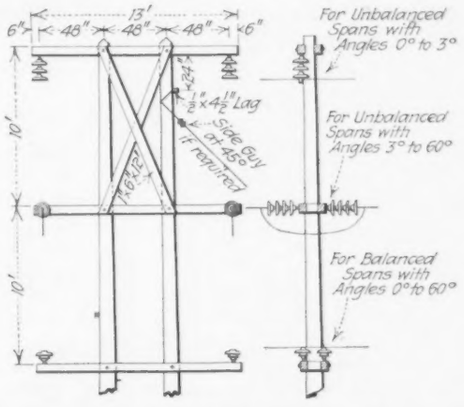


FIG. 1—TYPES OF CONSTRUCTION USED ON 45,000-VOLT LINES FOR THREE DIFFERENT CONDITIONS AND 600-FT. TO 1500-FT. SPANS (GREAT WESTERN POWER COMPANY)

and making H-frame towers which were cross-braced and guyed at numerous points. In another case the conductors were supported on a saddle carried by several pin insulators and the ends dead-ended at a special structure near the ground, thus avoiding the excessive bending moment which would have been exerted on the tower if strain insulators were used. This construction was not used so much for this reason, however, as to avoid depending on the tensile strength of disk insulators.

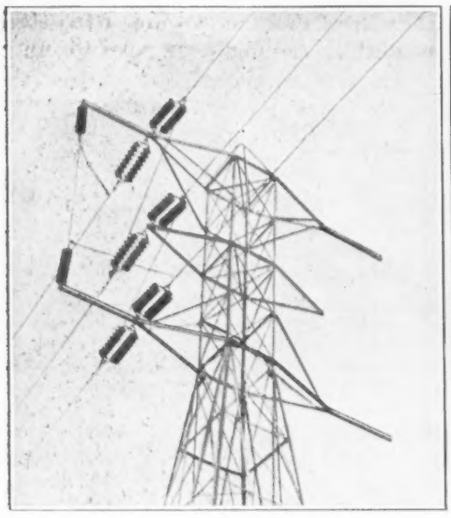
Various methods of preventing excessive stresses in the conductors have been employed. Sometimes the conductors are supported at such an elevation that large sags can be permitted. In other cases stranded steel wire of extra-high tensile strength or composite wire such as copper-clad steel, steel-core aluminum and stranded cable with a steel core has been used. Even high-strength steel messenger wire supporting a copper conductor has been employed.

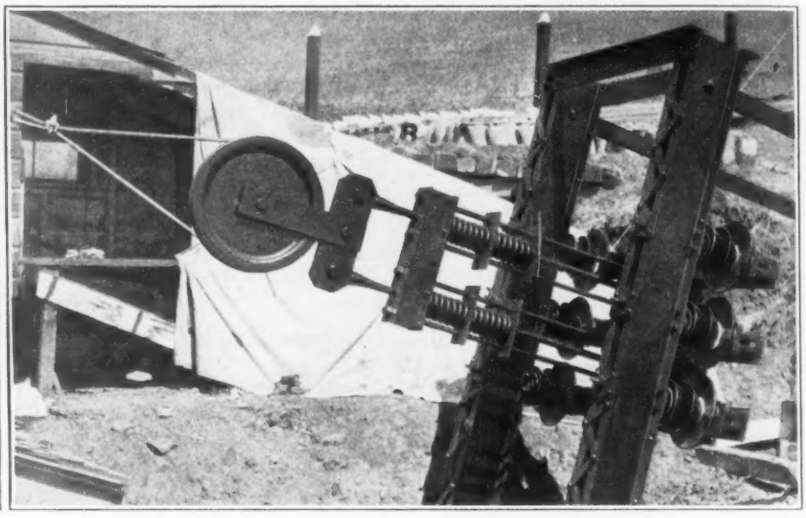
NOVEL METHOD OF SECURING UNIFORM TENSION

Allowance for expansion and contraction of the conductor due to temperature changes is especially necessary on long spans as the wires may be worked nearer the safe margin of their tensile strength than on moderate-span lines. In one case compensation for this change in conductor length is provided for to insure

uniform tensile strength at all times by attaching the tower side of the strain insulators to cables running over pulleys, thence down to large concrete weights inside the tower near the ground. The weights are provided on only one end of the span. Incidentally the construction relieves the insulators from sudden strains due to whipping of the conductors and reduces the bending moment on the tower on which they are installed.

Transmission of the conductor stresses to the supporting structures is a problem of no little importance on long spans. If pin-type insulators are used, it is necessary to support the conductors on them in such a way that no bending moment is exerted on the pins, and furthermore if several pin insulators are required to carry each conductor, as may be the case with exceedingly long spans, the stress must be evenly distributed over them. If disk-type insulators are used, it is not safe to depend on one string of insulators for transmitting the stress, at least for spans more than 1500 ft. (457 m.) in length. The real decision should be based, of course, on the tensile strength of the disks used and the margin of safety considered necessary.





FIGS. 2 AND 3—TRANSPOSITION ON 100,000-VOLT LINE (GREAT WESTERN POWER COMPANY); LONG-SPAN ANCHORAGE WHICH IS HOUSED FOR SAFETY AND TO PROTECT INSULATORS (PACIFIC GAS & ELECTRIC COMPANY)

Transmission of Stresses to Supports

One case in which pin insulators are used very successfully for supporting an exceedingly long span is at Carquinez Straits, this construction being referred to before. A saddle is provided over the insulators (several are used to support each conductor) to distribute the stress and also allow the conductor to slide and thus prevent lateral stresses in the insulators. Each conductor is dead-ended by being served around a pulley and clamped, the pulley in turn being connected to a yoke pressing against multiple pin insulators. Springs are connected between the pulley and yoke to relieve suddenly applied stresses.

Where disk insulators are used for transmitting the conductor stresses to the supporting structure they are usually connected in parallel for spans above 1500 ft. (45.7 m.) in length. There is not much difficulty in dividing the stress between two parallel strings, but with more than two there may be some unless properly designed equalizing yokes are employed. Some yokes for this purpose are arranged like the whiffletree on a two-horse vehicle so that the strings of insulators can be placed in one plane. Other yokes are constructed on the same principle, but the equalizing bars are arranged so that the insulators can be placed in two parallel planes as shown in the illustrations. In attaching the conductors to the insulators care must be taken not to bend the wire in too sharp a radius and not to injure the skin with clamps. In some cases the wires are bent around small pulleys attached to the insulators. When aluminum wire is used aluminum sleeves are advisable to protect the wire from the clamps.

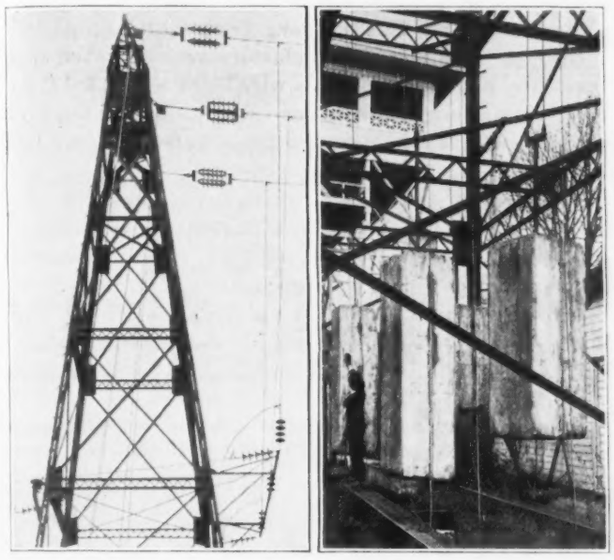
Surface Leakage

Surface leakage has caused more trouble than actual failure of insulators on the lines of the Southern Sierras Power Company, Riverside, Cal. In the dry climate of that section practically all the moisture in the poles and cross-arms evaporates so that the leakage from the iron pins chars and even burns the wood. To remedy this trouble the pins are metallicly connected by means of No. 9 galvanized iron wire stapled to the cross-arm and pole. The connection to the pins is made by wrapping the wire around the pin bolts under the washer and clamping it in place by screwing up the nuts.

At such places as river crossings and over rough country subject to slides and indented by deep ravines the Puget Sound Traction, Light & Power Company, Washington, employs spans of two to three times normal length supporting the conductors on A-frame towers made of two poles set 12 ft. (3.6 m.) apart at the base and bolted together at the top. No. 4 hard drawn solid copper and No. 4/0 and No. 2/0 seven-stranded aluminum conductors are used on the long spans. The wires are supported in triangular formation 7 ft. by 9 ft. (2.1 m. by 2.7 m.) apart. No difficulty has been experienced from the wires swinging together.

Wherever possible the wires are strung so that the tensions on each side of the supports are equal. Where this is impossible the conductors are dead-ended by strain insulators fastened to the cross-arms by eyebolts, and the towers are back-guyed. The aluminum wires, where dead-ended, are protected from damage by the clamps by aluminum sleeves 1/16 in. (0.15 cm.) thick. Long spans are computed for a stress in the con-

ductor up to the elastic limit at 0 deg. Fahr., a wind pressure of 50 miles (80.4 km.) per hour and a ½-in. (1.3-cm.) coating of ice. Wherever the ground clearance in the center of the span will permit, 10 per cent more sag is allowed than is usual.



FIGS. 4 AND 5—UNIFORM WIRE TENSION MAINTAINED BY COUNTERWEIGHTS

Tower-ends of insulators attached to cables leading over pulleys and running down to concrete counterweights weighing 10,800 lb. each. The span is 1792 ft. long, the conductors are made of ⅝-in. galvanized crucible-steel track cable, and four strings of five insulators are connected in multiple. (Portland Railway, Light & Power Company.)

On the Drum-Cordelia line of the Pacific Gas & Electric Company are two long spans, 4534 ft. (1382 m.) and 4033 ft. (1229 m.) in length respectively. The conductors consist of ¾-in. (1.9-cm.) nineteen-strand copper-clad steel and are placed 20 ft. (6.1 m.) apart. To prevent their swinging a spacing tower is erected in mid-span at a lower grade than the terminal towers; thus it has to support only a fraction of the weight.

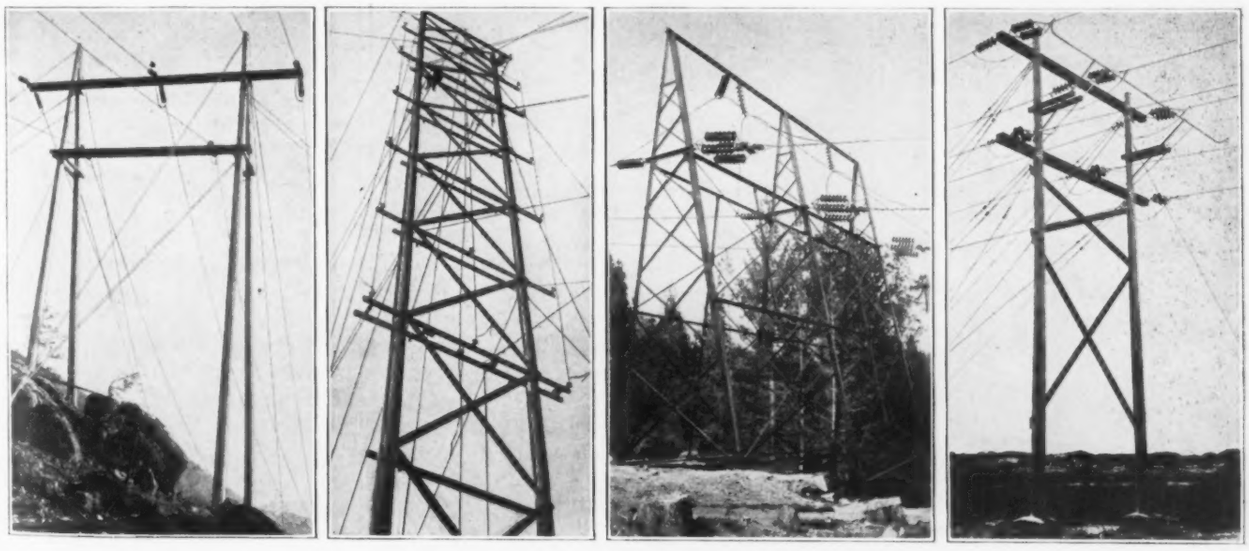
The anchorage at the terminal towers consists of four strings of eight Ohio Brass Keokuk type insulators assembled in such a way that the total tension is evenly distributed between them. As originally equipped, seven sets of insulator disks were used, but the number has been increased to eight to provide a larger insulating safety factor. Both spans are subjected to severe stresses at times owing to snow and sleet, but have given satisfactory service since 1913.

DETAILS OF SOME STRUCTURES EMPLOYED

Long spans are ordinarily divided into three classes by the San Diego Gas & Electric Company, viz., spans of from 1000 ft. to 1500 ft. (305 m. to 457 m.), of 1500 ft. to 2500 ft. (457 m. to 762 m.) and of 2500 ft. (762 m.) up. Two-pole structures without cross-bracing, known as type T, are used on spans of 1000 ft. to 1500 ft. Two-pole structures with cross-bracing, called type U, are employed for spans of 1500 ft. to 2500 ft. where the adjacent spans are less than 1500 ft. Two-pole structures with cross-bracing, distinguished as type V, are used for spans of 1500 ft. to 2500 ft. where adjacent spans likewise exceed 1500 ft., and three-pole structures, known as type S, are used for spans exceeding 2500 ft.

Conductors.—Regardless of the voltage, the conductors are of seven-strand extra-galvanized steel in one of three grades—high strength, extra high-strength, or a quality which falls between the two, manufactured especially for telephone messenger cables. For spans of from 1000 ft. to 2500 ft. considerable ⅜-in. (9.5-mm.) high-strength (11,500-lb.) steel has been installed. A large quantity of 7/16-in. (11.1-mm.) special high-strength (18,000 lb.) steel has also been used on spans of 1000 ft. to 3000 ft. On one span of 3069 ft. (936 m.) the company employs 7/16-in. (11.1-mm.) extra high-strength (22,500-lb.) steel.

At the point of attachment to the towers the conductors are usually bent around a cast-iron pulley wheel and are held by three or more three-bolt guy



FIGS. 6, 7, 8 AND 9—SOME LONG-SPAN STRUCTURES

The spans adjacent to the structure shown in Fig. 6 are 1175 ft. and 1325 ft. No. 1/0 A. W. G. seven-strand medium hard-drawn copper is used. Fig. 7 indicates a 135-ft. wood structure made of spliced poles supporting a 1611-ft. span. (Pacific Power & Light Company.) On the structure shown in Fig. 8 the anchorages consist of four strings of eight strain insulators in multiple. (Pacific Gas & Electric Company.) Fig. 9 represents a type U tower with 66-kv. line above and 11-kv. line below. This tower is set in concrete because of marshy soil. (San Diego Consolidated Gas & Electric Company.)

clamps. All long spans are sagged with a dynamometer, and a record is kept of the tension and stringing temperature of each span. No sleet is allowed for in the design, as none occurs in this territory.

Insulators.—Only one type of insulator is used independent of voltage. This is Locke No. 3538, having an average ultimate strength of 12,500 lb. (880 kg. per sq. cm.). On type T towers they are used in single strings; on type U and V structures in parallel strings, balanced by means of steel yokes, purchased from Pierson, Roeding & Company and especially manufactured for this company. On type S towers four parallel strings are used, spaced and balanced with double sets of interconnected strain yokes. For voltages of less than 11 kv. single insulators are used; for 11-kv. lines two insulators are used in each string, and for 66-kv. lines five per string.

Poles.—Class A, Western red cedar poles especially selected with large tops, are used when available; the butts being open-tank-treated. Type U structures have been constructed of a variety of sizes of poles from 40 ft. to 75 ft. (12.2 m. to 22.9 m.), depending on the clearance required. Some structures built on hillsides require poles of two different heights. Type S towers are ordinarily constructed of two 45 ft. (13.7-m) pole and one 60-ft. (18.3-m.) pole.

Where poles are erected in marshy ground or sandy soil they are set in concrete to obtain a greater bearing area and for protection against deterioration.

The guys are ordinarily made of the same material as the line conductor. Each pole is usually held by three guys. In addition to the main back guy, side guys and front guys are provided, the latter serving primarily to prevent the tower from whipping if a conductor should break. They are also useful during the erection of the line. In accordance with the state law, strain insulators are put in all guys, regardless of voltage. These are White No. 506 brown-porcelain strain insulators, having a rated ultimate strength of 20,000 lb. (1550 kg.). Two three-bolt guy clamps are used at each point of attachment, the strain insulators being similarly equipped with three-bolt guy clamps rather than wrapped splices. Galvanized-steel anchor rods ¾ in. (1.9 cm.) by 8 ft. (2.4 m.) long are used.

On type T towers the conductors are supported in a horizontal plane, each outside wire being separated from the middle one by a distance of 6.5 ft. (2 m.) On type U and V towers single cross-arms are used, the conductor separation being 11 ft. (3.4 m.). On type S towers no cross-arms are used as each conductor is attached directly to the pole. The conductors are arranged in a triangular formation with 20-ft. (6.1-m.) separation.

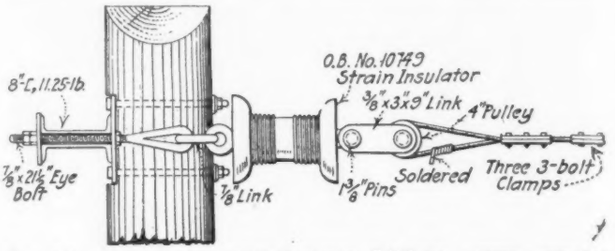
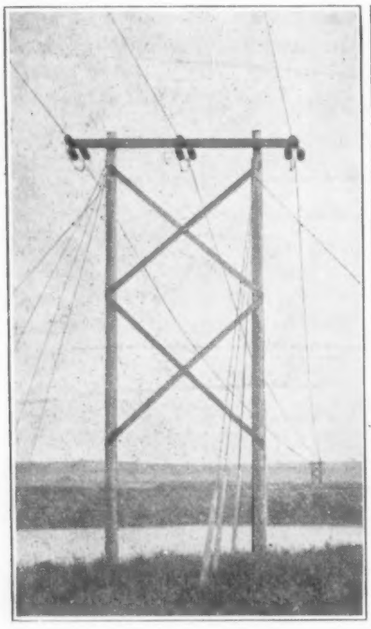
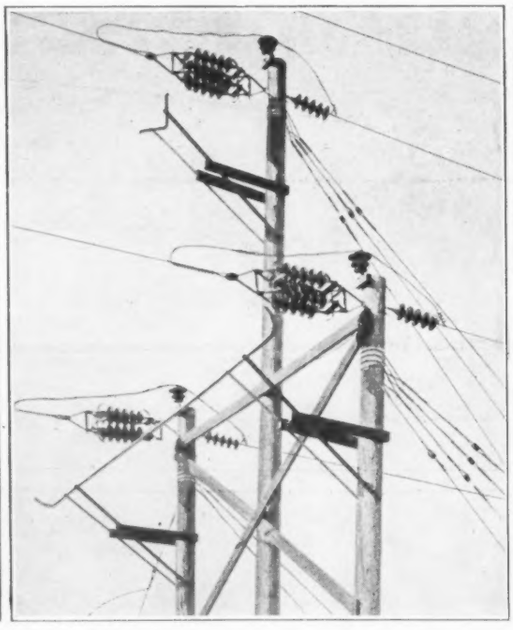


FIG. 12—METHOD OF DEAD-ENDING 5/16-IN. STEEL STRAND SUPPORTED FROM TOWER SHOWN IN FIG. 7

Most of the information on which this article is based was contributed by the following: E. W. Beardsley, general superintendent of the Great Western Power Company; R. H. Halpenny, electrical engineer of the Southern Sierras Power Company; W. C. Heston, acting superintendent department of wires and conduit, Portland Railway, Light & Power Company; H. H. Schoolfield, chief engineer of the Pacific Power & Light Company; M. T. Crawford, superintendent of transmission and distribution, Puget Sound Traction, Light & Power Company; P. M. Downing, chief engineer of the electrical department, Pacific Gas & Electric Company, and L. M. Klauber, superintendent of the electrical department, San Diego Gas & Electric Company.





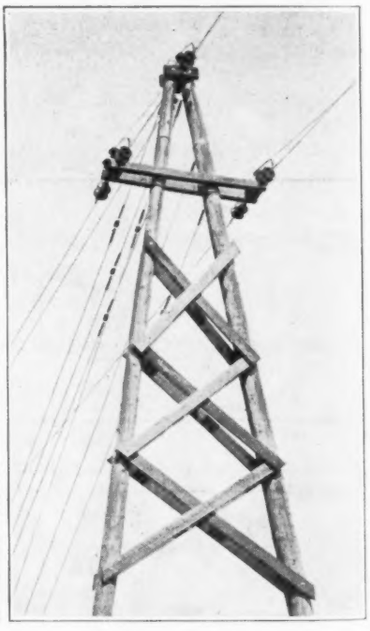


FIG. 10—TYPE U STRUCTURE USED ON 66-KV. LINE WITH 2195-FT. SPAN. FIG. 11—LINES DEAD-ENDED DIRECTLY ON POLES; THIS CONSTRUCTION IS SUITABLE FOR SPANS OF 2000 FT. FIG. 12—A-FRAME WOOD TOWER SUITABLE FOR SPANS UP TO 2000 FT. (SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY)

PRESENTING A CASE BEFORE PUBLIC UTILITY COMMISSION

Advice Concerning What to Do and What Not to Do in Order to Expedite the Handling of an Appeal for a Rate Revision

BY HAROLD L. GEISSE*
Secretary Railroad Commission of Wisconsin

THE utility desiring to obtain an increase of rates or the public desiring to contest an increase or to secure a reduction of rates usually confidently seeks the assistance of a lawyer, with a sublime trust in the ability of the legal profession to know what to do before any public body or on any public occasion. The lawyer, however, even though most skillful in the trial of cases before a court or jury, is very often as much at sea as his client on what to prepare for the hearing and how to present it. The result is that the commission is obliged to resort to an inquiry into the books and accounts of the company and to a statistical analysis of the operating performance of the plant for some years back or to extended service investigations in order to obtain facts upon which to determine whether or not the relief sought is justified, and in a fair percentage of the cases the record of the hearing is encumbered with a mass of irrelevant testimony, inexpert opinions and even vituperation, to which the commission has been obliged patiently to sit and listen.

One of the recurring incidents in the taking of hearings is the attempt to influence the judgment of the commission by the introduction of prejudicial matter. This is a method to be deplored, totally ineffective and unworthy of notice by opposing counsel.

THE PROPER SCOPE OF THE COMMISSION

The commission is not a court of law. Its business is to fix rates, to pass upon the character and quality of service, to pass upon rules and regulations under which service is given, to inquire into the methods of keeping accounts and the business management, to prevent the interference of one utility's lines and facilities with those of another, and to approve methods of construction. In performing these functions it is interested solely in finding out the facts. It is concerned in accounts, in operating statistics, in unit costs, in prices of materials and supplies, in coal costs, in values of property, in measurements and surveys, in traffic counts and in the opinions of experts.

One cannot attempt to outline a procedure for each character of case that may come before the commission. A service case will differ much in its method of presentation from a rate case, but, to illustrate how plain and matter-of-fact a case may be made, one can follow through in its simplest form a typical case in which rates are involved.

The elemental question in which the commission is concerned in a rate case is the determination of the value of the property used and useful in the service of the public. It is upon this fair value that the lump sum to be allowed as return is based. The lower the value found, the lower will be the rate schedule. In determining the ultimate fair value, the physical value of the tangible property, the amount of going value and the necessary working capital to be allowed must all be considered. The opportunity to affect the judgment of the commission commences with the engineering appraisal of the physical value of the property. The engineers of the commission have returned their report upon the physical value, and copies of the report have been submitted to both sides in the case. It is possible that in making the appraisal the engineers have overlooked some element of the property, have failed to allow for mishaps in building the plant which increased the money expenditure necessary to its construction, or to make allowances for other elements. On any of these points the commission would be glad to have enlightening testimony.

THE DIFFICULT QUESTION OF "GOING VALUE"

Having concluded the testimony on the physical valuation, the amount of going value and of working capital to be allowed are considered. The various theories of computing going value as discussed in textbooks, prior decisions and monographs of experts furnish a fertile field of inquiry for persons preparing to present a case before a commission, and the amount of working capital necessary to conduct any particular business is sufficiently vague and uncertain to afford the litigants opportunity to present very helpful testimony.

Completing the inquiry into the value of the property, an analysis of the expenses becomes necessary to determine that no improper charges are being included and whether or not the property is being fairly economically managed. If the case under consideration arises through a public attack on the rates charged, it is probable that the representatives of the public will be able to present little testimony of any considerable assistance. Frequently testimony is introduced showing that the rates charged by the company under attack are in excess of those charged by other plants similarly situated in communities of approximately the same size. Such testimony is usually of little significance because of the factors that make the amount of the investment and the operating costs vary in different communities.

If, on the other hand, the case arises through an application of a company for authority to increase rates, the company should be able to present a thorough analysis of its operating costs and earnings, together, if possible, with graphic charts showing tendencies over a long period. Prepared with sufficient care, such a statement can be of material assistance to the commission. Data relative to the degree of saturation attaincd in the community, presenting a statement of the kilowatt-hour sales per capita and the gross earnings on the per capita basis, can frequently be shown with considerable effect.

In placing these data in evidence an officer of the company should be prepared to explain them in detail, answering any questions relating thereto that may be propounded either by the commission or by representatives of the public. Similarly, carefully prepared data should be provided for presentation in any service case, the object being constantly in mind to cut down the extent of inquiry that the commission must make independently after the hearing before decision can be rendered. With the figures carefully compiled, introduced and explained at the hearing, only such investigations would be required as would satisfy the commission of the fairness with which they have been com-

*Excerpts from a paper read before the Wisconsin Electrical Association.

piled, their completeness and the safety with which conclusions may be drawn from them.

It is true that the commission has a more or less complete mechanism for the ascertainment of the facts in any inquiry it may be called upon to make. This is necessary in order that the evidence introduced in a case before it may be tested by subsequent independent investigation and that accounting and engineering assistance may be rendered to utilities and municipalities operating utilities. It is taking an advantage of the commission, however, for a utility to presume that the possession of a staff of engineers, accountants and investigators renders it an available agency for the investigation of the utility's affairs when the utility feels itself in need of aid in the way of higher rates or relief from service requirements. The utility, having full access to its own books, records and accounts, should, before seeking relief, prepare itself to draw its own conclusions as to its needs and the reasons therefor and should be in a position to convince the commission of the fairness of its cause.

A somewhat different situation exists where the public invokes the jurisdiction of the commission in securing relief from high rates or inadequate service. There the complainant has not the machinery at hand to conduct its own inquiry, but is obliged to depend to a greater or less degree on the inquiries made by the commission. Even here, however, the person in charge of the case, be he city attorney or private counselor, should have a sufficiently well prepared outline to present clearly the issues he wishes to draw and the grounds for the public belief that relief is justifiable.

Installation and Care of Reactors

Some of the Factors Which Are of Vital Moment in Their Operation but Which Are Usually Not Within the Control of the Designers Are Emphasized in This Article

BY M. E. SKINNER
Transformer Engineer, Westinghouse Electric & Manufacturing Company

CURRENT-LIMITING reactors are rapidly becoming indispensable adjuncts to electrical power-plant equipment, especially where a large source of power is concentrated in one plant—a marked characteristic of modern central station development. During the early days of the electrical industry the apparatus was of such small size and voltage that mechanical problems were not developed. With the increase in the size and concentration of generating equipment, however, the mechanical forces increased until weaknesses made themselves apparent, and to-day the electrical engineer's problems are probably as much mechanical as they are electrical.

WHERE WEAKNESSES FIRST APPEAR

Among the places where mechanical weakness first became evident may be mentioned the end windings of generators. Investigation disclosed that a majority of the early high-speed generators of large capacity would not stand a dead short circuit without considerable distortion of the end windings. There were two principal reasons for this weakness—first, the low inherent reactance of the early machines, which were built primarily for the close regulation demanded by a lighting load; second, a lack of appreciation on the part of designing engineers of the tremendous forces which could be developed. To protect such generators it was necessary to supply external reactors to limit the current under short circuit, as it was usually impossible to brace the windings more thoroughly without rewinding the machine. Modern machines combine high reactance with more thorough bracing in order to withstand the stresses due to dead short circuit.

The solution of the generator problems did not clear the situation, however, but simply removed the limitation from the generators to the next weakest link in the system. Whether this involves the circuit breakers, bus structure, transformers and other apparatus or not, the point is that as the available power back of a short circuit increases and the system becomes more nearly able to maintain its full voltage it becomes necessary to limit in some way the current which can be fed into the fault. Reactors have met this requirement quite satisfactorily.

The questions of how much reactance is required and where it should be placed in order to give the maximum protection have been the subject of numerous articles in the trade and technical papers[1] and they will not be discussed here. However, there are some factors which are vital to the successful operation of reactors that will be discussed as they are usually not under the control of designing engineers.

AIR-CORE REACTORS TO LIMIT CURRENT

Air-core reactors are invariably used for current-limiting purposes. Since this type of reactor is surrounded by a widespread magnetic field, it is impossible to immerse them in iron oil tanks without developing a very large stray loss. On account of the high temperatures caused by short-circuit currents, it is also impossible to use inflammable material for insulation. The common form of air-core reactor is a cylindrical coil with the turns supported at suitable intervals by a fireproof and non-magnetic structure. The conductor is bare and adjacent turns are insulated from each other by the air or by the supporting structure. The reactor problems which the central-station man is likely to encounter may be traced either to the limitations of

[1] "Protection Against Short Circuits," *Electric Journal*, Vol. X, p. 1217; "Protective Reactances for Large Power Systems," *Proceedings A. I. E. E.*, February, 1914, Vol. 33, p. 141; "Protective Reactors for Feeder Circuits of Large City Power Systems," *Proceedings A. I. E. E.*, October, 1914, Vol. 33, p. 1663; "Current-Limiting Reactances on Large Power Systems," London *Electrician*, Vol. 72, p. 1046; "Selection of Power-Limiting Reactances," *General Electric Review*, Vol. 17, p. 604; "The Application of Current-Limiting Reactors," *Electric Journal*, Vol. 13, p. 280.

air insulation or to those imposed by the widespread magnetic field.

The voltage across a current-limiting reactor, when carrying normal current, is seldom much more than 5 per cent of the voltage of one leg of the system. With the large number of turns which is usually required in a reactor, the voltage between adjacent turns under these conditions is below the value necessary to maintain an arc in air. However, under short circuit the voltage across the coil rises directly with the current, and it is under these conditions that there is danger of breaking down the air which constitutes the insulation. If the coils are installed on an ungrounded system, there is an additional element of danger introduced in the form of possible high transient voltages due to arcing grounds.

AIR A DEPENDABLE DIELECTRIC

Air itself is the most dependable dielectric which we have at our disposal. The difficulty lies, not with the dielectric, but rather in the ease with which it may be contaminated. Moisture, either rain or steam, metallic vapors or dust will lower the strength to a greater or less extent, depending upon the amount of the foreign substance present. Reactors are, therefore, fundamentally indoor apparatus. They should be housed so as to preclude the possibility of inclement weather affecting their insulation strength. They should not be installed where they will be exposed to steam, as even an amount so small that it would not weaken the air might condense on the surface of the structure supporting the turns and cause a breakdown at this point. Metallic vapors or dust have about the same effect. In no plant is it possible to eliminate dust completely, and for this reason a periodic inspection and cleaning of reactors is recommended. Providing a smooth surface on the reactor structure between turns will do a great deal toward minimizing the accumulation of dirt.

On account of the very high temperatures which may be attained under short circuit, inflammable material should not be used around reactors. The reason for the high temperature is that the heat-storing capacity of the parts of a reactor exclusive of those carrying current is negligible. Unlike a generator, a reactor has no heavy iron core and frame, nor is it immersed in oil like a transformer, either one of which will absorb the extra heat generated on short circuit so rapidly that the duration of the high temperature in the copper is generally not sufficient to injure the insulation.

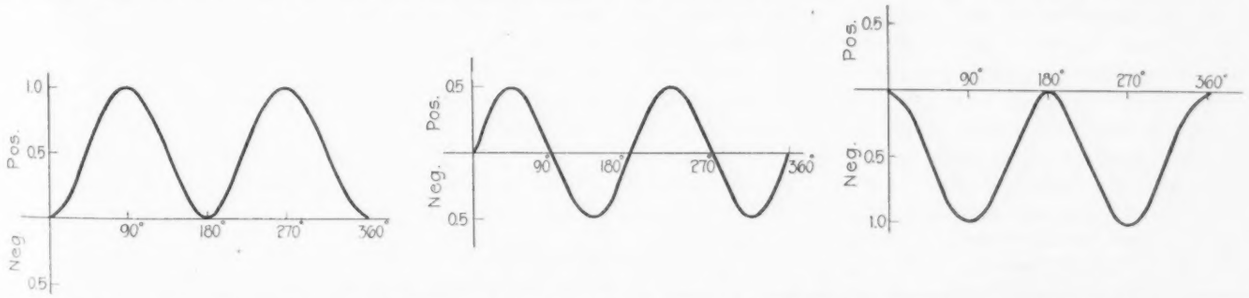
The short circuit conditions to which a coil will be subjected rather than the current which it is to carry normally should fix the rated temperature rise. The ultimate temperature which a coil will attain under short circuit depends upon the temperature just prior to the disturbance and the amount of copper in the coil. It is given approximately by the following relation:

$$T = \frac{(1 + cT_0)\, e^{R_0 I^2 ct/180W} - 1}{c}$$

Where T = final temperature in degrees C.
T_0 = temperature of the copper just prior to the short circuit in degrees C.
t = duration of short circuit in seconds.
R_0 = resistance of copper at temperature T_0 in ohms.
W = weight of copper in pounds.
I = short-circuit current in amperes.
c = coefficient of resistance per degree C.; = 0.00427 for copper.
e = base of Naperian logarithms.

Applying this formula to the case of 2 per cent and 5 per cent coils of the same current-carrying capacity having the same cross-section of copper we find that, though they operate at the same temperature when carrying full-load current, the 2 per cent coil will reach approximately 1150 deg. C. after a dead short circuit lasting two seconds, as compared with only 200 deg. C. in the case of the 5 per cent coil. From this example it is evident that the lower the percentage of reactance for a given current-carrying capacity the greater should be the cross-section area of the copper and, therefore, the lower the temperature rise under normal full-load current.

The amount of heat generated within the reactor can be controlled more or less largely in the design. Such provisions as the use of stranded conductors and the equalization of the impedance of parallel circuits, with consequent reduction in circulating currents, will do much to prevent excessive heating within the coil. To avoid a large expenditure for protection, it is common practice to design reactors so that a short circuit lasting approximately two seconds will not cause the temperature to reach dangerous values. This corresponds to automatic operation of the circuit breakers, with the maximum relay setting that is now considered good practice. In the case of bus-tie reactors the design should be more liberal. The designer should be informed of any special conditions, such as hand opera-



FIGS. 1, 2 AND 3—VARIATION IN FORCE EXERTED BY REACTORS ON EXTERNAL MAGNETIC OBJECTS UNDER DIFFERENT CONDITIONS

If both currents are in phase, the force is unidirectional and pulsating, as shown in Fig. 1. The effect of a phase displacement between the currents is to shift the curve toward negative values. As the angular displacement increases, the positive and negative peaks become more nearly equal, until when the currents are in quadrature the force alternates between equal positive and negative values, as shown in Fig. 2. If the displacement between the currents is still further increased, the shifting continues until, with currents completely out of phase, the conditions shown in Fig. 3 exist.

tion of circuit breakers, which might increase the length of time the reactors will be required to carry short-circuit currents.

External Conditions Affect Heating of Reactors

Unfortunately, the heating caused by a reactor is not all within the coil. The heat developed outside a reactor is due to the widespread magnetic field which surrounds the coil. It is of two kinds—first, electrical heating caused by the circulation of currents by transformer action in neighboring closed metallic circuits; second, magnetic heating caused by the alternating field in adjacent iron structures. A reactor may be considered as the primary of an air-core transformer to which any conducting circuit in the vicinity becomes a secondary. The current which will circulate in any secondary depends upon the closeness with which the primary and secondary are linked together, and upon the impedance of the secondary circuit.

The most common sources of trouble on this account are formed by the structural steel work of floors and ceilings, pipe railings or angle-iron frames supporting screens. To avoid trouble, either the coupling of the circuits must be made very loose or the impedance of the secondary must be made large. The former may be accomplished by arranging the reactors so that they are not coaxial with the meshes in the steel work and by using insulating joints in the pipe or angle frames and railings. Where it is impossible to avoid placing a reactor directly over or under such a closed circuit in the steel work the amount of circulating current can be minimized by increasing the distance between the coil and the steel work as much as possible.

In addition to the loss just described there will be a certain amount of heating in any magnetic material adjacent to a reactor due to hysteresis and eddy currents. The loss from this source depends upon the frequency and upon the flux density and can be limited only by keeping the material far enough away to limit the density. One of the most common places where this trouble is encountered is in the reinforcing of concrete floors and walls, where the temperature rise of the steel work must be kept low to avoid cracking the concrete.

To demonstrate the relatively great distances through which the magnetic field of a reactor is exerted, it is only necessary to walk past one when it is under load with a bunch of keys or other magnetic material in one's pocket. The attraction is quite considerable even some distance from the coil. Instances have been known where the number of ampere turns concentrated in a single air-core reactor has been as high as 135,000 under normal rated load, increasing to

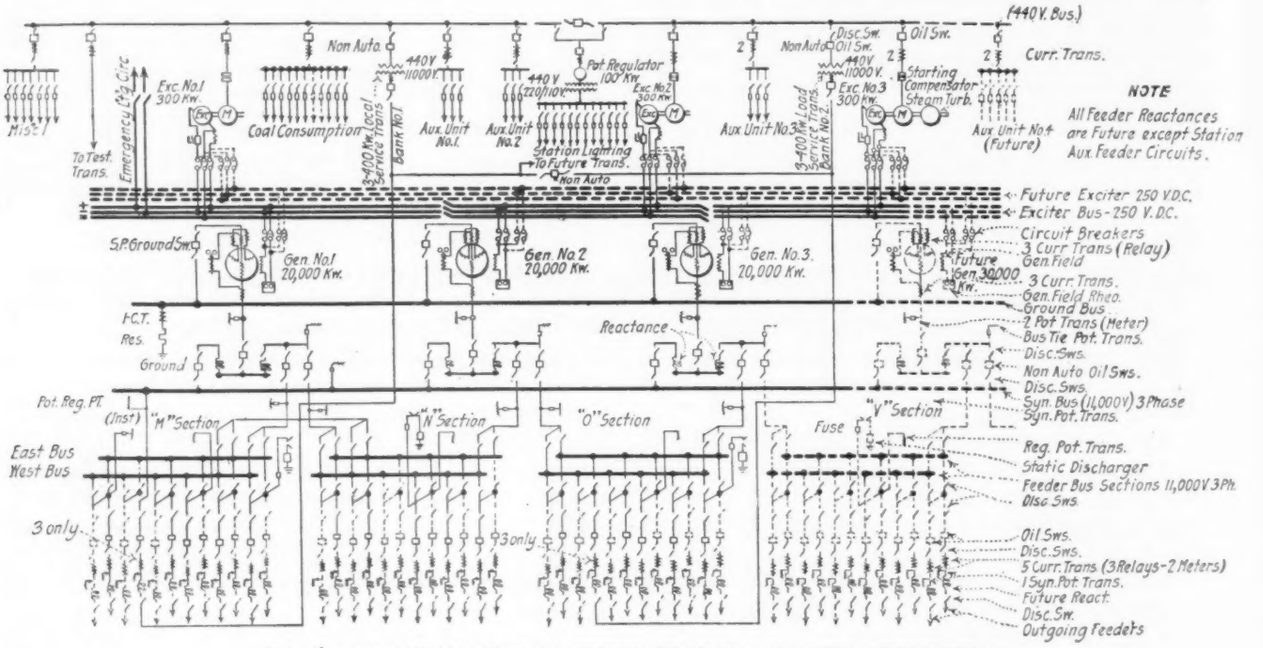


FIG. 4—AN INSTALLATION IN WHICH REACTORS ARE USED EXTENSIVELY

the enormous value of 1,700,000 ampere turns under short-circuit conditions. However, as the latter condition is only momentary, it need not be considered with regard to its influence on the heating in surrounding objects. The sphere of influence of a reactor not only depends on the number of ampere turns in the coil, but also, to a very large extent, upon the dimensions and the proportions of the coil. In general, the greater the diameter and the less the axial length the greater will be the area through which the field is exerted.

The temperature rise of magnetic material in the vicinity of a reactor is very much affected by the conditions of ventilation. Some results which were derived from tests are given in the table on the following page. Although the results thus attained cannot be applied directly to another installation, they indicate in a general way what may be expected and show the effects of the location and character of the material upon the temperature rise. The dimensions of the coil used for this test were as follows: Diameter over outside turn, 51¼ in. (130 cm.); diameter of inside turn, 37⅜ in. (95 cm.); axial length, 73 in. (185 cm.); turns, 54; current, 1600 amp. at 25 cycles.

Force Exerted on External Objects

Force is an instantaneous quantity, and the capacity which it has for doing damage is dependent upon its maximum value as contrasted with the temperature rises, which depend upon the average value of the

heating. Force coming from the interaction of alternating currents is always pulsating, being unidirectional at times and alternating at others (see Figs. 1, 2 and 3).

The peak value of the force is twice as great when the currents are in phase or completely out of phase as it is when they are in quadrature. The force may be considerably increased during the first instant of a short circuit owing to the unsymmetrical nature of the currents during this interval.

GENERAL LAW GOVERNING INTERACTION OF CURRENTS

The general law which governs forces coming from the interaction of electric currents is that the force is always in such a direction that the movement produced will increase the total amount of flux and the back emf. of the system. Applying this law to the case of an air-core reactor, four distinct kinds of stress may be produced:

(1) A stress between adjacent turns which tends to compress the current-carrying parts into a minimum cross-section at their electrical center. This crushing force tends to shorten the length of the restricted flux path and thereby to increase the flux.

(2) A stress on the whole coil, tending to increase the diameter and in that way decrease the reluctance and increase the flux.

(3) An attraction between the coil and any magnetic material in the vicinity. The greater the proportion of the total flux path which lies through magnetic material the lower will be the reluctance of the circuit. The force, therefore, tends to pull the magnetic material closer to the coil in an effort to decrease the reluctance.

(4) Mutual stress between adjacent reactors, which may be attraction or repulsion, depending upon the phase relation of the currents, but which always acts in a direction to increase the flux.

RESULTS OF TESTS ON THE TEMPERATURE RISE OF MAGNETIC MATERIAL IN THE VICINITY OF A REACTOR

	Distance (In.) from Outermost Conductor of Coil for Rise in Material of		
	15 Deg. C.	20 Deg. C.	25 Deg. C.
(1) ⅛-in. boiler plate, 36 in. by 60 in., located centrally above the reactance coil and in a plane perpendicular to the axis of the coil	36	30	25
(2) ¼-in. boiler plate, 50 in. by 60 in., located as in (1)	44	38	34
(3) 8-in. standard I-beam, 20¼ lb. per foot, located directly above reactor and perpendicular to the axis*	52	44	40
(4) Same as (3) above, except that it is located below the reactor*	29½	25½	23
(5) Screen of expanded metal 0.0938-in. iron, ¾-in. diamond mesh, 24 in. by 30 in., located above reactor and in a plane perpendicular to the axis of the coil	13½	11	10
(6) ⅛-in. boiler plate, 36 in. by 60 in., located at the side of the coil in a plane parallel to the axis	41½	34	29
(7) 5-in. standard iron pipe located as in (6)	31	26	22½
(8) 6-in. standard iron pipe located as in (6)	37½	29	25½

*Tests (3) and (4) show the effect of the heat carried to the magnetic material from the coil by convection.

The first two stresses mentioned above are entirely within the coil and cannot be influenced by the method of installation. The third type of stress has been proved by experience to be small enough to be neglected in most cases. If both reactor and metal work are securely fastened down, it will usually be found that the steel work will heat up unduly before the attraction becomes large enough to cause trouble. However, care must be exercised to make sure that there are no small magnetic bodies loose in the vicinity of the reactor which may be pulled into the coil, resulting in a short circuit between some of the turns. This is a danger which is often not fully appreciated. As pointed out previously, the number of ampere turns which are active at times of short circuit is often very large. At such times a reactor will attract loose magnetic material of considerable size. Bolts, nuts, screws and small tools, such as pliers and monkey wrenches, are among the things which should be particularly kept away from reactors. The writer knows of one reactor failure which was directly traced to trouble of this description.

The fourth type of stress—namely, the mutual force between adjacent reactors—depends upon the spacing of the reactors and upon the relative phase relations of the currents flowing through them. Methods have been developed for calculating these stresses to a very fair degree of accuracy. These methods all depend upon the principle that the force between two coils is proportional to the space rate of change of the mutual inductance between them. For the case of two coaxial coils, one above the other,[2] the methods are quite accurate. The case of two coils side by side on the same level, the axes being parallel,[3] is more difficult and the results will probably be more approximate. In general, formulas involving mutual inductance are rather tedious to work with, so that a rough and ready rule is perhaps of more value to the central-station man than the actual method of computing the stress. At least such a rule will serve to indicate when the more complicated computation should be carried out.

It has been found that when the adjacent reactors are separated by one-third of their diameter when side by side and one-half of their diameter when coaxial the mutual forces due to short circuits are within safe limits and external bracing between reactors will generally not be required. This rule applies only to three reactors on a three-phase circuit and is in terms of diameter over copper and separation from copper to copper. The arrangement which should especially be avoided is that where adjacent reactors may simultaneously carry short-circuit currents in phase with each other. This condition is likely to arise when two adjacent feeders enter the same substation or are carried in the same cable duct. A short circuit on the substation busbars, or a short circuit in one cable, which is severe enough to communicate itself to other cables in the same duct would then cause both of the adjacent coils to carry very heavy currents. Since the force is proportional to the product of the currents and turns and the currents are likely to be in phase, this condition will result in very high stresses.

[2]See "Calculation of Alternating-Current Problems," by Louis Cohen, p. 51; also "Repulsion and Mutual Inductance of Reactance Coils with the Same Axis," by H. B. Dwight, *Electric Journal*, May, 1918.

[3]See ELECTRICAL WORLD, June, 1916, Vol. 69, p. 1148.

Six-Unit Station Will Develop 165,000 Kw.

Some Features of the Latest Additions to the Northwest Generating Station of the Commonwealth Edison Company, Where Some 30,000-Kw. and 35,000-Kw. Units Are at Present Being Installed

SINCE the last article* on the Northwest generating station of the Commonwealth Edison Company appeared in the ELECTRICAL WORLD a considerable addition to the plant rating has been made and the design which was originally followed has been improved. To the original installation of two 20,000-kw., 4500-volt, 25-cycle machines have been added one 30,000-kw. and one 35,000-kw., 25-cycle, 9000-volt machine and two 30,000 kw., 60-cycle, 12,000-volt machines. One of the latter is still under erection and is expected to go into service within a short time. One of the original 20,000-kw., 25-cycle, 4500-volt machines (unit No. 1) has been temporarily equipped with a 60-cycle, 12,000-volt armature. As the station stands, therefore, it will be able to produce, when completed, 85,000 kw. of 9000-volt, 25 cycle energy and 80,000 kw. of 60-cycle, 12,000-volt energy. It will be among the largest stations in the world in point of total rating and for some years will probably be the only station able to produce 165,000 kw. from as few as six machines.

The coal-handling system, the water system and the general building plans have been completed as originally contemplated. In the boiler room a few changes were made. Ten boilers per unit without economizers were installed for the first 20,000-kw. machines. Five double boilers for the first 30,000-kw. unit were installed without economizers, on account of building limitations. For each of the last three horizontal units the steaming equipment consists of five double boilers with economizers. Another change in the boiler room consisted of installing the stoker drive for all except the first two units under the boiler-room floor instead of above. This change was made to secure greater flexibility.

The big changes were made in the turbine room. The features of the recent design here are in the large machines themselves, in the change from steam to electric drive for auxiliaries, in the excitation system, in the installation of a 440-volt power system for the principal auxiliaries, and in the relay and protective equipment.

The horizontal machines were installed on a level nearly 11 ft. (3.4 m.) higher than the vertical machines to give room for large condensing equipment and auxiliaries. The arrangement and numbering of the units is shown in Fig. 2. This layout was selected because it permitted the 25-cycle and 60-cycle switching equipment to be kept separate and at the same time eliminated any necessity of crossing the generator cables on their routes to the switch house.

Unit No. 6 is a compound reaction turbine driving a 60-cycle, 12,000-volt, three-phase star-connected generator rated at 30,000 kw. at 85 per cent power factor, or 35,300 kva. The turbine is of the tandem compound type, the two elements being connected by a solid flange coupling. The generator is connected to the turbine through a flexible coupling so that the three rotors turn as a unit. The turbine is served by two condensers. This machine, unlike unit No. 4, has no built-in fan for cooling the generator windings but is equipped with an external motor-driven blower. The 60-cycle unit, No. 5, now being erected is a duplicate of unit No. 6.

All of the horizontal units are equipped with direct-connected 230-volt exciters. The 125-volt excitation for the two 20,000-kw. vertical machines is supplied by a

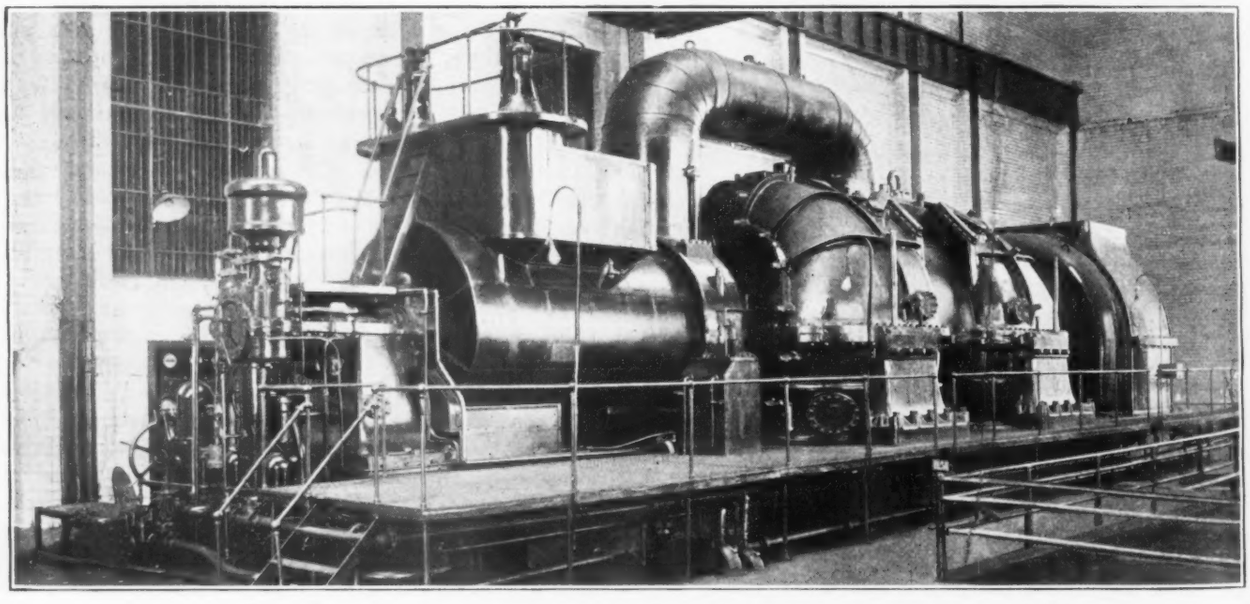


FIG. 1—ONE OF THE NEW TURBINE-GENERATORS RATED AT 35,300 KVA., 60 CYCLES AND 12,000 VOLTS

*Other articles in the ELECTRICAL WORLD dealing with the Northwest station of the Commonwealth Edison Company were published in the issues of March 17, 1910; June 1, 1911; Oct. 5, 1912; Jan. 11, 1913, and May 31, 1913.

300-kw. steam-driven and a 200-kw. motor-driven exciter. The motor-driven exciter has a sufficient range of voltage to permit it to be used for charging the control batteries. A system of connections has been installed by means of which this machine may be used as a reserve source of excitation for the horizontal units. Control of the field of each horizontal unit is accom-

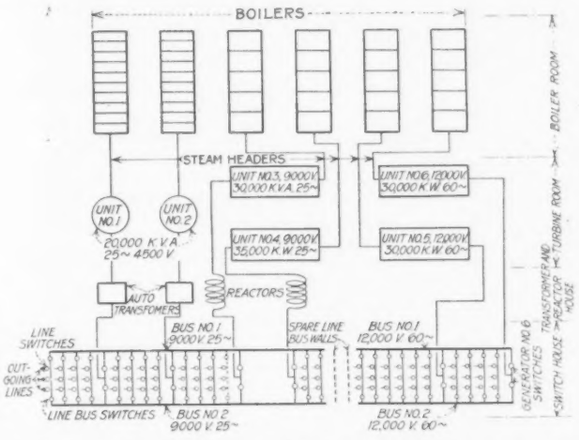


FIG. 2—ARRANGEMENT OF UNITS THAT PERMITS KEEPING 25-CYCLE AND 60-CYCLE EQUIPMENT SEPARATE

plished by manipulation of the exciter field rheostat, which is remotely controlled from the bench board in the operating gallery. A double-throw selector switch is provided so that the field rheostat of the reserve exciter can be controlled by the normal field-control switches when desired (Fig. 3).

The advantages of this scheme of connections are that it permits control of a unit from its own control panel, and after a change-over from normal to reserve excitation has been made the method of operation is not changed. The selector switches and solenoid-operated generator field switches, as well as the field rheostats for each direct-connected exciter, are grouped in sheet-iron cabinets on the turbine-room floor adjacent to the base of the unit they serve, except in the case of unit No. 4, where a special panel has been installed near the unit. Here they are readily accessible for inspection or emergency operation.

The previously mentioned selector switch is of the double-blade type to permit the selection of the normal or the reserve source of excitation without interruption of generator load. Both the double-pole, solenoid-operated generator field switch and the ammeter shunt are connected in the leads to the generator field so that the same equipment serves in both normal and emergency operation. The field switch is also under the control of protective relays on the generator, as is explained later in connection with protection. Sectionalization of the reserve excitation supply cable at several points was also resorted to for confining trouble on these circuits. As a further precautionary measure spare armatures for all direct-connected exciters are carried in stock.

RELAYS AND OTHER GENERATOR PROTECTIVE DEVICES

All generators are equipped with balanced relays of the modified Merz-Price type. The system of connections used is shown in Fig. 4. The relays are placed in the switch-house basement on concrete piers so constructed as to preclude any possibility of the relays being operated by vibration. In addition to this the relays are inclosed in locked cabinets. The engineers of the company have recognized that, while the relays are very desirable equipment, they are delicate and must be treated accordingly. The operation of the relays is somewhat unusual in that they not only "clear" the machine from the system but also cut off excitation, and in the cases of units No. 5 and No. 6, which have external fans, also cut off the ventilation.

When the relays are tripped they perform the following functions in the order mentioned: First, open main generator oil switches; second, open generator field switch and generator neutral switch, the time element being obtained by auxiliary control contacts on the generator oil switches; and third (in the case of units No. 5 and No. 6), cut off energy supply to the motors driving ventilating fans. This sequence of operations was selected to minimize the rush of current into the generator which would occur if the field switch were to open at the same time as the first oil switch. It was thought advisable to provide for stopping the ventilation in order to reduce damage from fire.

Among the other interesting devices installed on the generators are exploring coils connected to pyrometers in the operating gallery. Temperature coils which operate on the same principle as the exploring coils are also installed in the air intakes of the machines. By means of these coils the temperature of air entering the machines can also be read in the operating gallery. These coils are of value in checking the operation of the air washers, of which enough are now installed at the plant to supply about 500,000 cu. ft. (14,000 cu. m.) of pure air per minute.

In the air ducts of units No. 5 and No. 6 an additional precaution against operating without ventilation has been taken. It consists of a small pivoted vane hung in the air duct. As long as air is being forced through the duct the vane is held in an approximately horizontal position. Should the air supply fail, the vane drops to a vertical position and gives an audible alarm in the operating gallery and a visible signal in the turbine room.

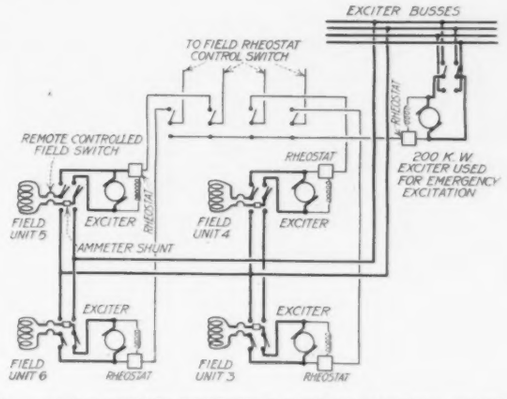


FIG. 3—DOUBLE-THROW SWITCHES PERMIT CONTROL OF RESERVE EXCITER FROM NORMAL FIELD-CONTROL SWITCHES

Plans have been made for a future installation of a three-pole oil switch in the neutral leads of each generator. Under present conditions these leads are tied together and joined with a single-pole oil switch. A three-pole switch installed in this connection would assist considerably in speedily clearing trouble which may occur on any one or several phases of the generator.

GENERATOR LEADS, SWITCHES AND BUSES

In the three neutral leads from each unit are installed current transformers for connection to the balanced relays. The 500-amp. single-pole neutral oil switches and the 25-cycle machines are connected to a bus which is connected to ground through a 2.5 ohm. grid resistor having 2000 amp. carrying capacity for one minute. The neutral connections of the 60-cycle machines are similarly connected to a separate ground bus with a 3-ohm resistor. Each generator lead consists in general of two lead-covered cables in parallel, ranging in size from 1,250,000 circ. mil to 1,750,000 circ. mil. They are installed in concrete compartments, are insulated by means of 6-in. (15.24-cm.) tubes of special material and are held in place by non-combustible clamps in special concrete barriers placed about 3 ft. (0.91 m.) apart. Cable and bells are installed on all individual lead covered cables.

The cables from each of the two large 25-cycle machines, units No. 3 and No. 4, are connected with porcelain-clad reactors installed in specially ventilated rooms in the transformer house. The reactors are rated at 6.25 per cent for unit No. 3 and 3.5 per cent for unit No. 4. The total reactance of each generator with its external reaction is approximately 12½ per cent. Arrangements for disconnecting and short-circuiting the reactors have been made. The 60-cycle machines having 12 per cent internal reactance do not require external reactors.

Beyond the reactors the leads from unit No. 3 consist of two double-braided cables in parallel which are supported by porcelain insulators. The leads from unit No. 4 are standard insulated copper busbars supported on similar porcelain insulators. Lead-covered cable was used in the turbine room, principally on account of steam, space limitations and special cable runs.

Formerly the lead sheaths of generator cables were grounded at one end through two 1-amp. fuses shunted by the primary winding of a potential transformer.

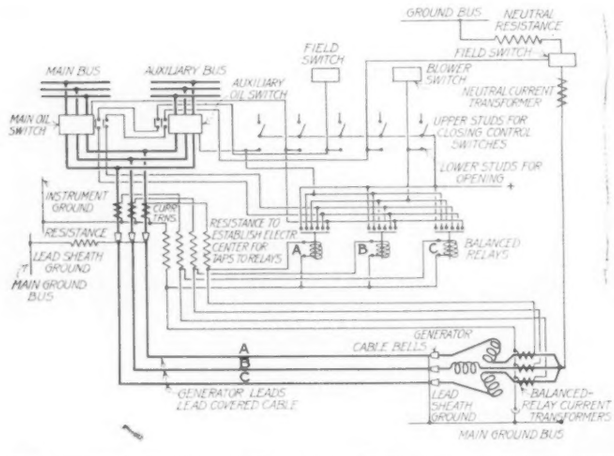


FIG. 4—RELAYS INSTALLED IN BASEMENT ON CONCRETE PIERS TO PRECLUDE VIBRATION

The secondary winding being connected to an alarm was supposed to notify attendants if excessive current flowing to ground through the lead sheath had blown the fuses. Now one end of the cable is connected solidly to ground. The other end is grounded through a 10-ohm carbon resistance. This arrangement is designed to minimize the flow of current in the lead sheath set up by transformer action. This change was made when the balanced relays were installed because they gave positive protection in case of breakdown of generator cables as well as in case of breakdown in the generator.

The generator leads from each unit except No. 4 are connected to the two high-tension buses through 2000-amp. H-6 oil switches. For unit No. 4 the switches were increased to 3000-amp. rating. It is interesting that these switches occupy cells of the same size as the 2000-amp. units, but the oil pots are somewhat larger. The 3000-amp. switches are the largest of their type. Installed in connection with them are lock-bolt disconnecting switches of a type similar to those installed with the 2000-amp. switches. The feature of these "disconnects," in addition to their size, is that they positively lock in the open and in the closed position and the operating handle cannot be removed from the switch when the switch is in an intermediate position. To facilitate operating these large and heavy disconnecting switches a special pulling device has been provided (Fig. 5).

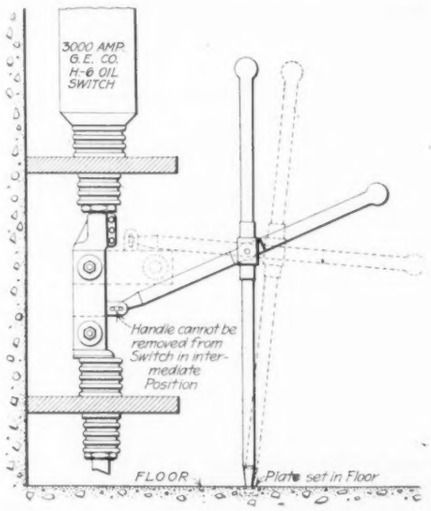


FIG. 5—DEVICE FOR OPERATING DISCONNECTING SWITCH CANNOT BE REMOVED EXCEPT WITH SWITCH IN OPEN OR CLOSED POSITION

The spare line bus walls are installed between those connected to 25-cycle unit No. 4 and those to 60-cycle unit No. 5. In addition to the four line bus walls per unit, two spare line bus walls with space for six transmission lines have been provided. This arrangement provides spares between the 60-cycle and the 25-cycle equipment. Just now it is difficult to say whether they will be needed on the 25-cycle or the 60-cycle system. When the time comes for their use, however, no complications will arise in making the most desirable division of the spares between the two systems.

The switching equipment for these generators and transmission lines is installed in the portion of the switch house which was built later than the original section. This portion differs from the original layout only in that it provides a basement for cables. The first floor contains high-tension buses and bus compartments. The second floor houses the oil switches and "disconnects" and the third floor the oil-switch mechanisms. Since the company's rules require that the transmission lines shall be grounded through oil switches, a special device has been worked out for this

purpose. It consists of a copper rod screwed to the fork of the oil switch and connected at its upper end to a ground bus through a flexible conductor. Other features of the switch house are the testing cabinets installed on the second floor for each unit and the signal-lamp system energized by potential transformers on each transmission line to show operators which lines are alive.

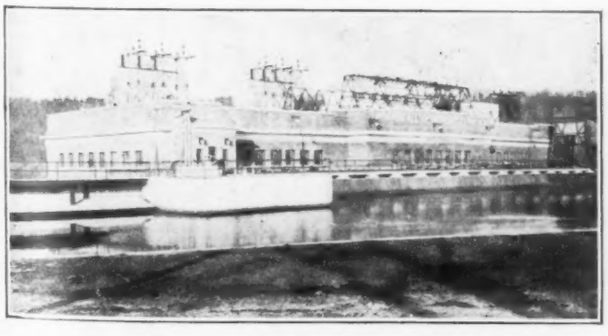
This article will be concluded in a later issue.

WATER-POWER PROGRESS IN NEW ENGLAND STATES

The Relation Between Steam Relay Plant and Hydroelectric Development Is Analyzed by President of Turners Falls Company

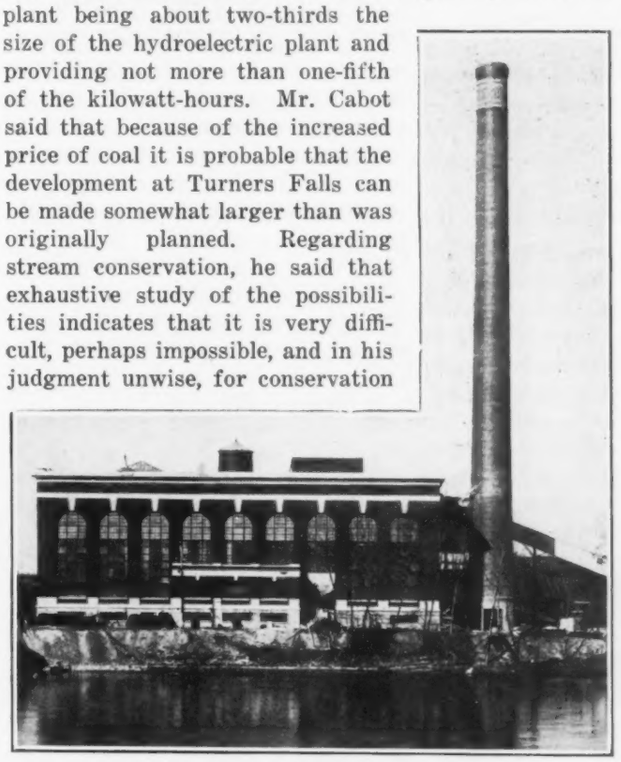
An interesting analysis of the relation between steam relay plant capacity and hydroelectric development was recently presented before the Massachusetts Gas and Electric Light Commission by Philip Cabot of Boston, president of the Turners Falls Power & Electric Company. In connection with the issue of additional securities since authorized by the commission, Mr. Cabot was asked to explain some of the broader economic considerations bearing upon the construction of the new Hampden steam plant of the Turners Falls company and incidentally to set forth the underlying conditions governing the development of the Connecticut River. Closely related to the company's program of plant construction is the problem of supplying power to the Springfield Street Railway.

The Hampden steam station at Chicopee, Mass., at the junction of the Chicopee and Connecticut Rivers, is now rapidly approaching completion for its initial service. The first unit, of 15,000 kw. rating, is due for delivery in May, 1918, and a second unit of the same size is due for delivery at the end of this year. The estimated cost of the station with one 15,000-kw. unit installed, as at first contemplated, was about $1,500,000. With two units installed the estimated cost is $2,250,000. The ultimate capacity is 60,000 kw. and as much of the work has been done for the final development, including intake and headworks, much of the foundations and a great part of the underground work and coal handling system, the unit cost of plant for the first two machines is considerably higher than the probable unit cost of the whole station.



HYDROELECTRIC PLANT OF TURNERS FALLS COMPANY

Assuming that the hydroelectric development at Turners Falls is 60,000 hp. and that a reasonable part, say one-fourth, of the possible storage on the Connecticut River is provided in some way, Mr. Cabot said that roughly 40,000 hp. of relay would have to be maintained against that water power. The water power will provide 75 or 80 per cent of the annual kilowatt-hours taken out of the development, the steam plant being about two-thirds the size of the hydroelectric plant and providing not more than one-fifth of the kilowatt-hours. Mr. Cabot said that because of the increased price of coal it is probable that the development at Turners Falls can be made somewhat larger than was originally planned. Regarding stream conservation, he said that exhaustive study of the possibilities indicates that it is very difficult, perhaps impossible, and in his judgment unwise, for conservation on a large scale to be undertaken by private interests.



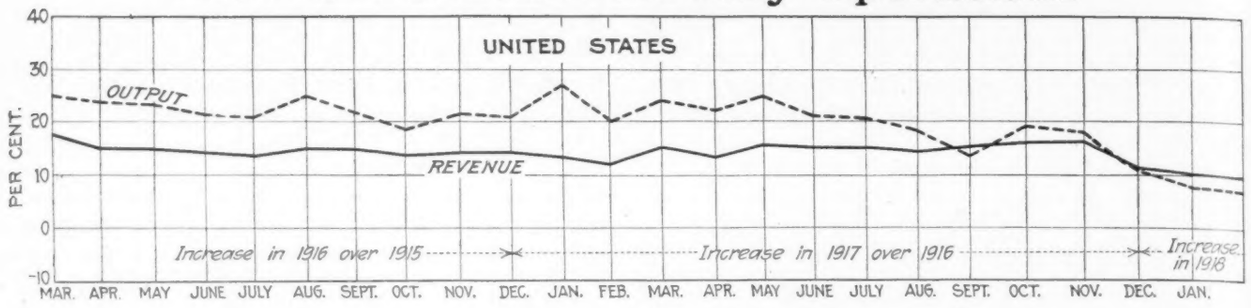
HAMPDEN STEAM PLANT AT TURNERS FALLS

Mr. Cabot said that there is no possibility of providing in the watershed of the Connecticut River enough storage to make the flow of the stream permanent. Some relay would be necessary even if the power existed to-day and the money were at hand to store all the water which can be stored in the watershed.

The Turners Falls company spent about three years in negotiating with the Springfield Street Railway for the power contract now in vogue. As the negotiations proceeded it became clear that if the railway company was to make a contract it would have to be made for the entire supply of energy and that the investment of the railway in its generating station would have to be eliminated in some way. The Margaret Street station in Springfield is a direct-current steam plant of about 12,000 hp. rating and has little value for operating purposes in connection with a hydroelectric system like that of the Turners Falls company. It is expected that the Market Street and Westfield plants will be dismantled as the Turners Falls company takes on the railroad load. These plants have been purchased by the Turners Falls company.

The Springfield Street Railway has signed a twenty-year power contract with the Turners Falls company, and at present three 1500 kw. motor-generator sets are providing the local service required from Margaret Street as a distributing center, the incoming line pressure being 66,000 volts at the outdoor substation adjoining the motor-generator and operating room.

Central-Station February Operations



CENTRAL-STATION INCOME AND OUTPUT GAIN IN PER CENT BY MONTHS FOR NATION

STATISTICS of revenue and output in February show that the central stations experienced in that month about the same retarding influences which they felt in January. Companies reporting to the ELECTRICAL WORLD, representing 52 per cent of the industry, had an increase of 9.6 per cent in the revenue from sales and of 7.1 per cent in kilowatt-hour output as compared with February, 1917.

In other words, the rate of increase in energy produced and in the revenue therefrom continued at a lower level during the second month of the year. It is encouraging that increase was maintained notwithstanding the various factors which operated to reduce production at that time.

Some of these factors were temporary, others must be accepted so long as the war lasts. Changes in requirements of customers, according as they are engaged in essential or "less essential" production, will have to be anticipated. Coal shortage must be reckoned with. The industry-closing order of Fuel Administrator Garfield is not generally accepted as a precedent to be repeated, but while the nation is at war any remote contingency may become a fact without warning.

It is interesting to see that in February as in January the rate of increase in revenue was maintained better than the rate of increase in output, showing that the curtailment in consumption was mostly from the heavy power users. While the underlying conditions are unusually complex, it is probable that rate increases entered into the ultimate result of larger gain in revenue than in output.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE-MONTH PERIOD

Month	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1917	1916	Per Cent Increase	1917	1916	Per Cent Increase
March	64	23,949,000	20,913,000	14.6	1,409,129,000	1,139,453,000	23.6
April	63	22,927,000	20,165,000	13.8	1,328,092,000	1,085,554,000	22.5
May	62	23,359,000	20,307,000	15.2	1,459,085,000	1,163,483,000	25.3
June	63	23,279,000	20,168,000	15.6	1,407,860,000	1,165,629,000	20.8
July	63	22,768,000	19,680,000	15.8	1,397,482,000	1,159,410,000	20.5
August	63	22,718,000	19,972,000	13.8	1,451,928,000	1,223,373,000	18.7
Sept	63	23,861,000	20,896,000	14.3	1,376,370,000	1,219,117,000	13.0
Oct	62	25,748,000	22,334,000	15.4	1,522,149,000	1,279,140,000	19.0
Nov	62	26,665,000	23,183,000	17.0	1,485,370,000	1,292,113,000	15.1
Dec	58	28,144,000	25,026,000	12.4	1,517,001,000	1,362,299,000	11.3
		1918	1917		1918	1917	
Jan	61	27,085,000	24,538,000	10.3	1,749,971,000	1,624,432,000	7.7
Feb	52	21,583,000	19,691,000	9.6	1,117,326,000	1,043,291,000	7.1

For the entire industry the ELECTRICAL WORLD calculates, from the returns for 52 per cent of the industry, that the February figures were: Revenue, $41,506,000; output sold, 2,148,000,000 kw.-hr.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States			Percentage of Industry Represented	Pacific and Mountain States		
			1917	1916	Per Cent Increase		1917	1916	Per Cent Increase		1917	1916	Per Cent Increase		1917	1916	Per Cent Increase
REVENUE	March	64	$2,861,000	$2,547,000	12.3	65	$10,203,000	$8,902,000	14.7	56	$6,692,000	$5,754,000	16.5	86	$4,193,000	$3,780,000	11.0
	April	64	2,756,000	2,357,000	17.0	65	8,601,000	7,765,000	10.7	56	7,132,000	6,094,000	7.0	86	4,282,000	3,821,000	12.1
	May	64	2,640,000	2,253,000	17.2	65	9,495,000	8,118,000	16.9	52	6,912,000	5,914,000	16.9	86	4,173,000	3,883,000	7.5
	June	64	2,641,000	2,290,000	15.4	65	9,281,000	8,017,000	15.7	53	6,718,000	5,563,000	20.9	86	4,480,000	4,174,000	7.4
	July	64	2,634,000	2,205,000	19.4	65	8,919,000	7,687,000	16.1	53	6,690,000	5,643,000	18.6	86	4,482,000	4,110,000	9.2
	August	64	2,352,000	2,025,000	16.2	65	9,021,000	7,881,000	14.5	53	6,910,000	5,718,000	20.9	87	4,819,000	4,270,000	21.9
	Sept	64	2,811,000	2,362,000	19.0	64	9,139,000	7,963,000	14.7	53	7,232,000	6,177,000	17.1	87	4,636,000	4,355,000	6.4
	Oct	64	3,057,000	2,530,000	20.7	66	10,683,000	9,173,000	16.5	52	7,422,000	6,304,000	17.8	85	4,586,000	4,327,000	6.1
	Nov	64	3,391,000	2,834,000	19.7	65	10,159,000	8,873,000	14.5	52	8,454,000	7,063,000	19.7	84	4,661,000	4,410,000	5.9
	Dec	64	3,483,000	2,999,000	16.1	58	10,834,000	9,949,000	8.8	48	8,935,000	7,464,000	19.7	82	4,892,000	4,614,000	0.6
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan	62	3,393,000	2,990,000	13.8	63	9,590,000	9,440,000	1.5	51	8,513,000	7,327,000	16.1	84	5,049,000	4,781,000	5.6
	Feb	62	2,976,000	2,760,000	7.8	52	8,438,000	7,813,000	8.0	44	6,107,000	5,323,000	14.7	78	4,062,000	3,795,000	7.0
			1917	1916			1917	1916			1917	1916			1917	1916	
KW.-HR. OUTPUT	March	64	121,434,000	95,515,000	27.2	65	539,028,000	425,376,000	27.0	56	383,046,000	311,841,000	23.0	86	365,541,000	301,721,000	21.3
	April	64	108,968,000	87,237,000	25.0	65	449,445,000	362,752,000	24.0	56	390,103,000	317,505,000	22.9	86	368,557,000	309,474,000	19.1
	May	64	110,991,000	86,675,000	28.3	65	527,004,000	405,719,000	30.3	52	415,795,000	325,986,000	27.7	86	394,554,000	336,541,000	17.3
	June	64	106,817,000	87,345,000	22.4	65	496,784,000	392,905,000	26.5	53	393,770,000	318,316,000	23.6	86	399,622,000	358,727,000	11.2
	July	64	109,399,000	83,451,000	31.4	65	494,965,000	396,538,000	24.8	53	379,087,000	311,931,000	21.5	86	412,635,000	366,237,000	12.7
	August	64	105,848,000	85,113,000	24.5	65	514,254,000	420,806,000	22.3	53	415,966,000	333,549,000	24.7	87	413,462,000	381,353,000	8.3
	Sept	64	114,339,000	92,319,000	24.0	64	482,112,000	405,070,000	19.0	53	399,480,000	345,953,000	15.5	87	379,221,000	374,685,000	1.4
	Oct	64	121,666,000	94,853,000	28.5	66	589,242,000	472,619,000	24.5	52	417,018,000	351,713,000	17.0	85	394,223,000	359,955,000	9.6
	Nov	64	130,311,000	108,561,000	20.0	65	532,301,000	445,537,000	19.6	52	443,374,000	384,480,000	15.2	84	379,384,000	357,535,000	6.1
	Dec	64	135,703,000	111,342,000	21.8	58	548,316,000	486,368,000	12.7	48	437,264,000	367,534,000	12.8	82	395,518,000	377,058,000	4.8
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan	62	125,212,000	111,339,000	12.4	63	474,647,000	463,763,000	2.3	51	604,247,000	552,960,000	9.2	84	545,865,000	496,370,000	10.0
	Feb	62	109,487,000	102,263,000	7.6	52	391,526,000	362,625,000	5.3	44	291,850,000	277,850,000	5.0	78	324,463,000	300,548,000	7.9

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

ASCERTAINING BOILER-ROOM INSTRUMENT PRACTICE

Central-Station Company Contemplating the Purchase of Measuring Equipment Needed to Effect Economies Distributes Questionnaires

Contemplating the purchase of a complete quota of boiler-room instruments and the establishment of a bonus system for firemen, one Middle Western operating company mailed questionnaires to nearby plants of similar size with the idea of finding out what its neighbors were doing. Of the eight companies reporting seven have boiler-flow meters and seven have CO_2 apparatus. These companies produce 10,000,000 kw.-hr. to 67,000,000 kw.-hr. annually. Five of the seven recognize that the installation of these instruments has permitted them to effect economies. All eight companies have draft gages, six of the eight have water meters, and seven have recording thermometers on the feed water. Three use coal scales of some sort, and a like number depend on the mine weights or number of car loads for records.

Some sort of bonus system for boiler-room employees is used by only three out of the eight. One of these was certain that the bonus system effected economies in operation. From the information contained in this questionnaire and from a study of its own conditions the company decided to install a more adequate complement of boiler-room instruments.

IDLE GENERATOR IS USED TO IMPROVE POWER FACTOR

Connected with Load End of Transmission Line by Parallel Reserve Circuit and Operated as Synchronous Condenser

It is not unusual to connect a synchronous machine to some part of a circuit to improve the power factor, but a company in New England has found a method of doing this which utilizes any generators which may be idle. This is made possible by the fact that it has duplicate transmission lines running from its main generating station, only one of which is ordinarily required to carry the load. The other circuit is provided for emergency use and also to take care of future increases in load. When the power factor gets low the duplicate lines are paralleled at their distant ends, and any generator that may not be carrying load is connected to the reserve line. It is then allowed to run as a synchronous motor, being excited enough to compensate for the low power factor at the delivery end of the line.

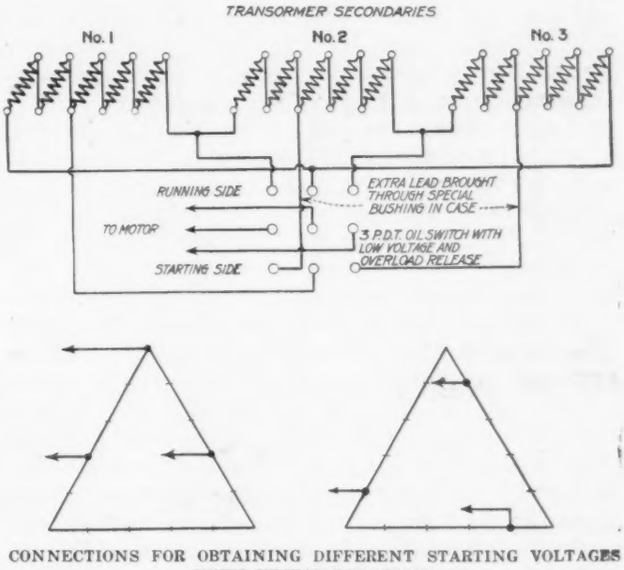
A slight load can be put on the generator if necessary to secure the desired wattless current by allowing some water to flow through the waterwheel.

This arrangement, besides utilizing equipment that would otherwise be idle, improves the power factor in both the line and the generators carrying load, whereas if it was merely floated on the bus as a synchronous condenser it would not benefit the line. By so doing it is also possible during a sleet storm to circulate enough current through the reserve line to melt any sleet which may adhere to the conductors.

TRANSFORMER CONNECTIONS ELIMINATING AUTO-STARTERS

Can Be Easily Arranged to Give 53, 60 or 72 per Cent Normal Voltage, Depending on Starting Torque Necessary

Where transformers arranged for three-wire secondaries are connected in delta for service to three-phase motors the neutral points may be connected to one side of a double-throw switch to provide half voltage for starting. This scheme is one which has been much used in the past and should never be overlooked in emergency cases.



CONNECTIONS FOR OBTAINING DIFFERENT STARTING VOLTAGES WITH VECTOR RELATIONS

A modification of this system may be readily applied where transformers having 2300/460-volt secondaries are in use to furnish low voltage for starting 2300-volt motors. In such transformers only two secondary leads are available, and it is necessary to run an extra lead out of the case. If connections are made as shown in the upper part of the accompanying illustration, 53 per cent of full voltage can be procured for starting. This will ordinarily afford good starting torque without an excessive rush of current.

This connection was recently used successfully in operating a 350-hp. motor from three 100-kva. transformers after the auto-starter had burned out. The

double-throw oil switch was equipped with low-voltage and overload release. If this voltage is insufficient, 60 per cent or 72 per cent normal voltage may be obtained by tapping, as shown by the vector diagrams at the bottom of the illustration.

CONSOLIDATION OF TWO CENTRAL-STATION SYSTEMS

Conditions in Memphis Were Unfavorable for Unification, but It Was Accomplished with the Apparatus at Hand Without Interrupting Service

When the Merchants' Power Company and the Consolidated Memphis Gas & Electric Company of Memphis, Tenn., were taken under one management the engineering department was confronted with the problem of connecting two dissimilar systems in the most effective manner. The first-mentioned company furnished most of the energy to the underground business district, and the latter supplied the remainder and the overhead residence section. The Merchants' plant was equipped with 4000-volt generators that were connected directly to the business district by means of seven four-wire overhead cables. The Consolidated plant supplied 2300-volt electric service to the transformer primaries in the business district through fourteen single-phase, two-conductor feeders in separate ducts.

When the cut-over was made the Merchants' plant was shut down and its service was supplied from the 2300-4000-volt transformers at the Consolidated power house. The fourteen two-conductor cables were reconnected to serve as six four-wire feeders for the 4000-volt system. The cables were originally designed fifteen years ago for 4000 volts, but had been used at only 2300 volts up to the time of the change-over.

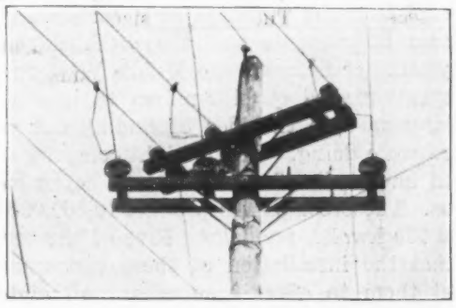
As the cables became heavily loaded during the peak hours, additional feeder capacity was necessary for emergency purposes. Fortunately a municipal electrical pumping station supplied by two 6600-volt cables was situated near the old Merchants' plant though fed from the Consolidated plant. In it were three 667-kva., 4000-6600-volt transformers through which energy could be supplied from the Merchants' plant in case of accident to the Consolidated station. An auxiliary line was therefore run from the 6600-volt cable to the Merchants' plant, where arrangements were made to step down the potential to 4000 volts and to feed back to the business district by means of the old 4000-volt feeders from the Merchants' plant.

This method of unification permitted the cut-over to be made without the purchase of new equipment, permitted the two dissimilar generating systems to feed the same cut-overs without changing the secondaries and provided workable emergency operating conditions. The coal consumption per kilowatt-hour of the Merchants' plant was about twice that of the Consolidated, and therefore considerable economy was effected when the latter assumed the load. The main difficulty in unification was the changing from two-wire to four-wire circuits. It was found that a four-wire system in two cables had doubled the reactance of a single four-wire feeder in one duct. Under the conditions existing at the time—high price of equipment, poor deliveries, etc.—however, this trouble had to be overlooked.

SPECIAL CLAMPS PERMIT THE SECTIONALIZATION OF LINE

With Tools Adapted Particularly to This Purpose the Clamps Can Be Connected or Disconnected While the Line Is Energized

By dead-ending its lines at points where it may be desirable to sectionalize them in case of trouble and by connecting these sections with jumpers and special conductor clamps, a Southern electric-service company has made it easy to isolate the sections at any time. These clamps, which are of the Johnson type, are constructed so that they may be connected or disconnected safely (see ELECTRICAL WORLD, Vol. 57, page 1346)



CONDUCTOR CLAMPS CAN BE REMOVED TO SECTIONALIZE LINE

while the line is energized with the use of a simple device on the end of a switch hook. Thus the expense of higher-priced disconnecting devices is avoided. The installation illustrated is on a 13,200-volt line.

NAMING PACKAGE QUANTITIES IN ORDERING COPPER WIRE

Class of Service for Which the Wire Is to Be Used Should Determine Whether It Shall Be Ordered in Reels or Coils

In placing orders for overhead copper conductors it is necessary to determine whether shipment should be made in coils or reels. This is especially true on large orders or where a specific character of construction is in view. Manufacturers' standard package quantities differ considerably, and often reductions may be made in construction costs by specifying packages suitable for the work in hand.

For large jobs reels are to be preferred. The greater length of the pieces minimizes splicing and permits pulling longer sections at a time. Furthermore, the wire can be easily run off the reels clean and is free from kinks. Large crews are usually available on such work, so no difficulty should be experienced in handling the heavy reels. The reels may be mounted on cable-reel jacks, on reel wagons or on trucks specially equipped for wire pulling.

On the other hand, wire which is to be used on a multitude of small installations should be ordered in coils to expedite the issuance of supplies and handling by small crews in the field.

One company having these requirements in view specifies packages as follows:

No. 8 weatherproof, 75 per cent in 50-lb. coils, 25 per cent in 100-lb. coils.

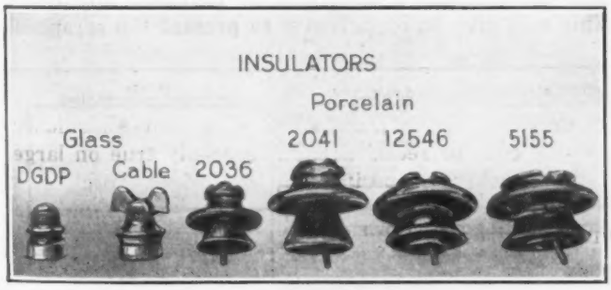
No. 6 weatherproof, 50 per cent in 125-lb. coils, 50 per cent in 250-lb. coils.
No. 4 weatherproof, 250-lb. to 300-lb. coils.
No. 2 weatherproof, 600-lb. to 800-lb. reels.
Nos. 1 and 1/0 weatherproof, 1000-lb. to 1200-lb. reels.
Nos. 2/0 and 4/0 weatherproof, 1500-lb. to 1800-lb. reels.
Nos. 6 to 2 bare, 1000-lb. reels.
Nos. 1 to 2/0 bare, 1500-lb. reels.

No. 8 weatherproof wire, being used exclusively for services, is ordered in small packages so that it may be issued directly to service wagons without cutting or re-reeling. No. 6 weatherproof conductor is used for short secondary extensions, series circuits and other light work and is therefore ordered in small and medium coils suitable for such work. No. 4 is also used in moderate lengths, but the lighter coils are found unnecessary. The larger sizes are generally employed only on more extensive jobs and are therefore ordered exclusively on reels. The same is true of bare wire in all sizes. This, being used only on high-voltage distribution systems or transmission lines, is invariably ordered on large reels.

USING MATERIAL CATALOGS FOR INVENTORY PURPOSES

Assist Inspectors Who Are Not Familiar with Equipment and Are Also Useful for Other Purposes

In making inventories of overhead distribution systems difficulties are experienced in securing inspectors sufficiently familiar with line construction materials to list them correctly in detail. One company recently engaged in making a complete inventory for use in a rate hearing before a state public service commission provided its inspectors with illustrated catalogs showing in detail line hardware and appliances with ap-



PHOTOGRAPHS OF EQUIPMENT AID INSPECTORS MAKING INVENTORIES

propriate names and style numbers. A group cut from one of these catalogs is reproduced. A number of such sheets were provided, showing respectively cross-arms, bolts and braces, clamps, pins, brackets, anchors, strain insulators, grounding devices, cut-outs, lightning arresters, pin-type insulators, disconnecting switches, mast arms, lamp reels and hangers, time switches and dead ends. The smaller devices were shown grouped in single photographs; the larger ones required separate sheets for each style.

It was found that photographs were cheaper to prepare than diagrammatic sketches, besides which they were more easily identified in the field. After the inventory was completed the booklets were found of service to inspectors checking completed work and to line foremen ordering material from the storeroom. Such a catalog will in fact be found useful for any central-station employee engaged in the purchase, handling or utilization of line materials.

HIGH-GRADE COAL FIRED DURING PERIOD OF PEAK

Emergency Measure Is Also Utilized to Good Advantage During Plant Construction When Boiler Deliveries Are Slow

Influx of war industries coupled with slow deliveries of equipment made the problem of carrying last winter's peak a difficult one for the Moline plant of the Moline-Rock Island Manufacturing Company, which supplies electric service to the "Tri-Cities," Davenport, Rock Island and Moline. Boiler capacity appeared to be the limiting factor. In order, therefore, to obtain the maximum rating out of the existing equipment only high-grade coal was burned during peak hours. Under ordinary conditions Iowa coal was burned.

Getting the high-grade fuel on the fires at the critical time was the chief problem. The difficulty was surmounted by constructing auxiliary bunkers for the high-grade southern Illinois coal. They were constructed of wood and were set almost against the fronts of the 500-hp. boilers in an elevated position so that they could be emptied into the stoker hoppers during peak loads by operating a metal-bound wooden gate. The clearance between these bunkers and the boiler fronts was just sufficient to afford ventilation and to give space for operating levers. The auxiliary bunker in front of each 500-hp. boiler holds 3 tons of coal. Coal was delivered to these auxiliary hoppers by the same machinery that conveyed coal to the overhead bunker that holds the supply of ordinary coal. When the high-grade coal had to be distributed chutes were arranged under the conveyor so that the coal would be dumped into the auxiliary bunkers instead of the main bunker. With underfeed stokers it was possible to get as much as 300 per cent of rating out of the boilers with this arrangement, but with the chain-grate stokers 175 per cent of boiler rating was about the limit that could be obtained.

At the Fort Dodge (Iowa) Gas & Electric Company, which is under the same management as the Davenport company, the same idea was utilized in a different way and for a different purpose. In constructing the plant permanent arrangements were made to fire two kinds of coal in order to reduce the investment which would otherwise be necessary for additional steaming equipment. The boiler plant at Fort Dodge consists of 500-hp. boilers with a sectionalized 17-ton bunker divided into two equal parts. One part is for Iowa coal and one is for southern Illinois coal. Duplicate spouts are provided to each stoker hopper. During the peak, or at times when transmission line failure places extra load on the plant, it is possible to get at least 20 per cent increase in rating over the best that can be obtained with Iowa coal. It may be possible to get even better performance. The great saving in this instance comes, however, from the saving of investment in one entire boiler equipment, which would amount to around $22,000.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

INNOVATION IN ADVERTISING ON CUSTOMERS' STATEMENTS

Washington Company Gives Discount Coupon Besides a Different Cooking Recipe Each Month to Be Pasted in a Scrapbook

An interesting innovation has been introduced by the Potomac Electric & Power Company of Washington, D. C., by the addition of a special advertising and discount coupon to its monthly service bills. The Potomac company's bill is printed in four sections, the bill proper carrying the amount and detail of the charge with a cashier's "tear-off" coupon at the right which is to be returned with the check. At the left of the bill, however, is a special advertising panel featuring at the top an attractive picture lithographed in many colors and illustrating a nursery rhyme which appears beneath it. Below this is an advertisement of some appliance which is being advocated particularly that month; at the bottom of the coupon is a notice to the effect that the holder of this coupon is entitled to a special 10 per cent discount on all cash purchases of appliances made during that month, while on the reverse of this coupon is printed a cooking recipe. At the left of this advertising panel is a "tear-off" for the collector which is sent to the collection department when the bill is rendered, in case the account stands in arrears.

This bill, which is reproduced here, is exceedingly attractive in appearance. The entire form is lithographed, and the advertising panel, being in bright colors, is assured of a reading. The plan goes further, however, as is announced on this particular bill. The company has prepared a "Nursery Rhyme and War Recipe" scrapbook which will be given to any customer for the purpose of pasting up and saving these rhymes and recipes. The result will be not only a little file of recipes which will have a value for the housewife and a little file of illustrated nursery rhymes which will appeal to the children, but also a little file of pictures and descriptions of electrical household appliances which will have an advertising influence of some permanence.

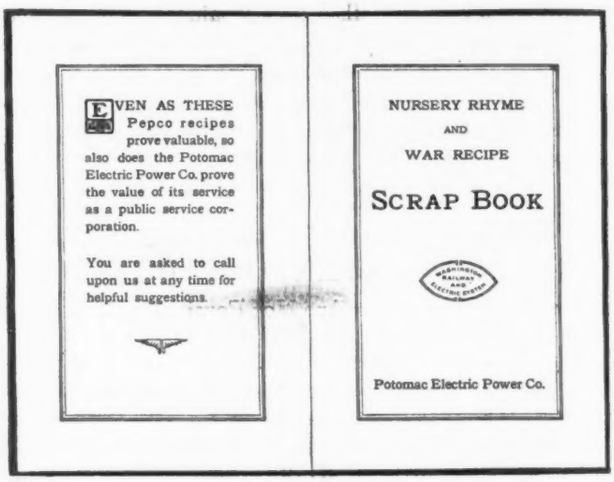

EVEN AS THESE Pepco recipes prove valuable, so also does the Potomac Electric Power Co. prove the value of its service as a public service corporation.
You are asked to call upon us at any time for helpful suggestions.
NURSERY RHYME
AND
WAR RECIPE
SCRAP BOOK
Potomac Electric Power Co.

FIG. 2—SCRAPBOOK GIVEN TO CUSTOMERS

The offer of the 10 per cent discount to the holder of the coupon is expected to bring a large number of people into the company's salesroom to purchase appliances. This will give an opportunity to present the scrapbook and paste in the first rhyme and recipe, which will insure the distribution of a very large number of books.

J. C. McLaughlin, commercial manager of the company, says: "We figure that the additional cost of adding this advertising panel to our bills is exceedingly profitable when we realize that for $1,800 more it will

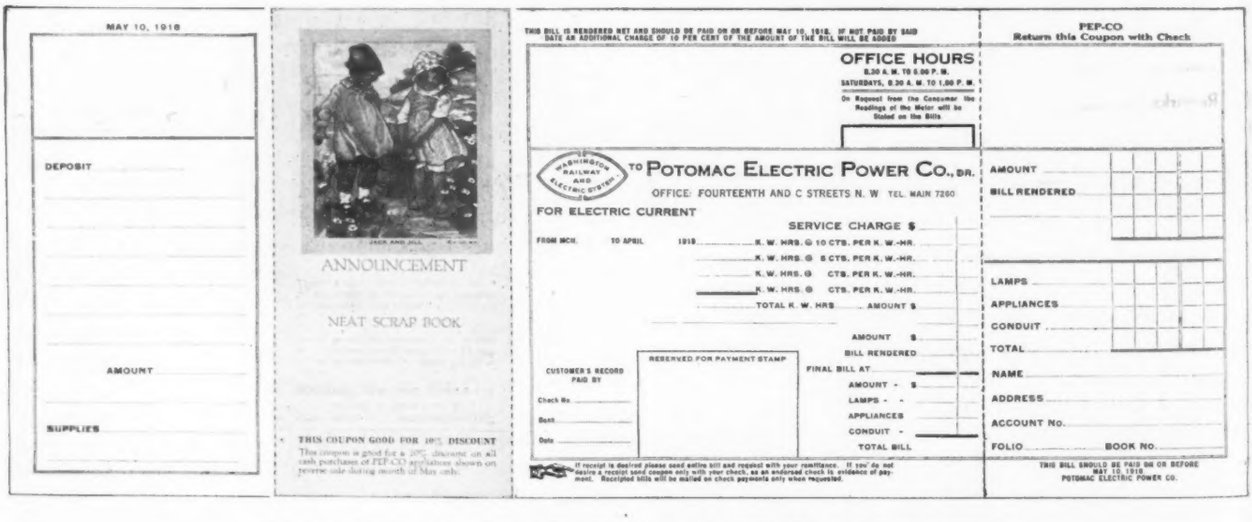

MAY 10, 1918
DEPOSIT
AMOUNT
SUPPLIES
ANNOUNCEMENT
NEAT SCRAP BOOK
THIS COUPON GOOD FOR 10% DISCOUNT
THIS BILL IS RENDERED NET AND SHOULD BE PAID ON OR BEFORE MAY 10, 1918. IF NOT PAID BY SAID DATE AN ADDITIONAL CHARGE OF 10 PER CENT OF THE AMOUNT OF THE BILL WILL BE ADDED
OFFICE HOURS
8.30 A. M. TO 5.00 P. M.
SATURDAYS, 8.30 A. M. TO 1.00 P. M.
On Request from the Consumer the Readings of the Meter will be Stated on the Bills
TO POTOMAC ELECTRIC POWER CO., DR.
OFFICE: FOURTEENTH AND C STREETS N. W. TEL. MAIN 7260
FOR ELECTRIC CURRENT
SERVICE CHARGE $
FROM MCH. TO APRIL 1918
K. W. HRS. @ 10 CTS. PER K. W.-HR.
K. W. HRS. @ 8 CTS. PER K. W.-HR.
K. W. HRS. @ CTS. PER K. W.-HR.
K. W. HRS. @ CTS. PER K. W.-HR.
TOTAL K. W. HRS. AMOUNT $
AMOUNT $
BILL RENDERED
FINAL BILL AT
AMOUNT - $
LAMPS - -
APPLIANCES
CONDUIT -
TOTAL BILL
CUSTOMER'S RECORD PAID BY
Check No.
Bank
Date
RESERVED FOR PAYMENT STAMP
If receipt is desired please send entire bill and request with your remittance. If you do not desire a receipt send coupon only with your check, as an endorsed check is evidence of payment. Receipted bills will be mailed on check payments only when requested.
PEP-CO
Return this Coupon with Check
AMOUNT
BILL RENDERED
LAMPS
APPLIANCES
CONDUIT
TOTAL
NAME
ADDRESS
ACCOUNT No.
FOLIO
BOOK No.
THIS BILL SHOULD BE PAID ON OR BEFORE MAY 10, 1918
POTOMAC ELECTRIC POWER CO.

FIG. 1—SERVICE BILL OF WASHINGTON (D. C.) COMPANY, SHOWING COUPONS

distribute during the year over 500,000 advertisements, each one a direct appeal for business with an appealing, human-interest feature. More than $64,000 worth of appliances were sold out of the company's display room last year, and we are confident that this new system will greatly increase our sales through 1918. Our appliances all carry a 50 per cent profit. This allows us ample margin for the 10 per cent discount offered to the coupon holders, which of course covers cash purchases only. This particular bill, being the first of the series and announcing the plan, does not exactly follow out the form of display which will be standardized hereafter, the 'ad' being on the back."

Another interesting feature of this bill form is a list on the back of thirty-seven banks and trust companies to which the bill may be paid by arrangement with the power company if such payment is more convenient for the consumer.

REDUCING THE DELINQUENT ACCOUNT BY 80 PER CENT

Central Station Obtains Excellent Results in Twelve-Month Period by Building Up Collection Organization

In one year the Muncie (Ind.) Electric Light Company reduced its delinquency account from $12,591.98 to $2,225.51, or more than 80 per cent. This was done, says C. L. Walling in the *Bulletin* of the American Gas & Electric Company, the parent organization, first, by creating the office of manager of collections; second, by insisting upon a deposit with each contract; third, by never closing the books on a bad account, and, fourth, by keeping continually after the old offenders and educating them to pay their bills promptly. The

Name _____ Folio _____

Address _____

Amount _____

Business _____ J. E. No. _____ Date _____

Remarks _____

FIG. 1—FRONT OF CARD FOR DELINQUENT FILE

following figures serve to show how well this plan worked out:

	1917	1916
January	$11,008.94	$7,444.22
February	10,348.00	9,064.80
March	6,839.73	9,672.39
April	6,703.13	9,461.24
May	5,513.07	10,302.97
June	5,140.99	11,038.65
July	5,123.06	12,278.54
August	5,144.66	10,441.52
September	5,017.13	10,393.71
October	4,510.52	12,350.35
November	4,913.11	15,597.56
December	2,225.51	12,591.98

A file of 3-in. by 5-in. (7.6-cm. by 12.7-cm.) alphabet cards (as shown) is kept of accounts charged off as uncollectible, which furnishes quickly the following information: Name, address, amount, ledger folio, business, journal entry number, remarks. The reverse side is ruled so that an itemized account can be quickly entered.

During the year 1917 the company received many payments which are attributed to this card system. At the last of the month the new-business Ford is bor-

	LIGHT	POWER	MDSE.	CASH
Jan.				
Feb.				
Mar.				
Apr.				
May				
June				
July				
Aug.				
Sept.				
Oct.				
Nov.				
Dec.				
Total				

FIG. 2—BACK OF CARD FOR DELINQUENT FILE

rowed for a few days and a big drive on delinquents is made by the collection department.

Delinquent letters are sent out as soon after the tenth as possible to every delinquent account, and the delinquent list is kept up to the minute.

HANDLING MOTOR AND WIRING ORDER CREDITS

Short Sketch of Office Routine by Large Middle Western Lighting Utility in Matters of This Nature

In taking care of credit matters on orders for motors or for wiring the practice of one of the large central stations of the Middle West is as follows:

If applicant for motor or wiring is a consumer, both his service and mercantile accounts are scanned and if habit of pay is good the order is approved. If payment is slow or the customer's account would not justify the amount or terms of the order, the customer is so notified and payment in full or in part, as the case may be, is requested in advance.

Should the applicant not be a consumer, his rating, if any, is looked up, his references are investigated, and if found satisfactory the order is passed. If investigation proves otherwise, applicant is notified and advance requested, and a copy of such notice is filed seven days ahead, which, if not acted on, is removed from the file and a second or follow-up letter is written, a copy of which is also held seven days, at which time the con-

tract is canceled and returned to the contract department if the applicant's check is not received. In some cases in the sale of motors, exhaust fans, etc., chattel mortgages are requested to enable the company to recover property should the applicant default in payment.

PROFIT FOUND IN PUSHING THE SALE OF APPLIANCES

Conditions That Have Been Brought About by the War Make an Active Market, Particularly for Household Goods

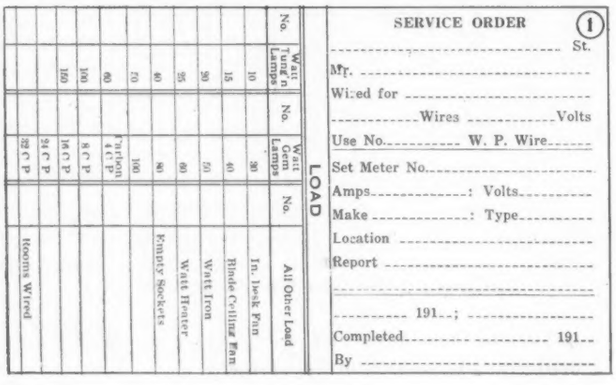
The New Orleans Railway & Light Company has gone to work to overcome the added cost of war-time conditions through 1918 by increasing the sale of electrical appliances. This policy was put in force the beginning of the year, and it is interesting to note that the February sale of merchandise totaled 458 appliances with a sales price of approximately $6,300, against 346 appliances sold in February last year with a total value of $3.600. The month before total sales were $5,700, as against $2,600 for 1917, and this great increase in gross sales was secured very largely by vigorously pushing the more expensive goods, such as vacuum cleaners, sewing-machine motors and washing machines, on which the retail profit is naturally large as compared with the small heating devices.

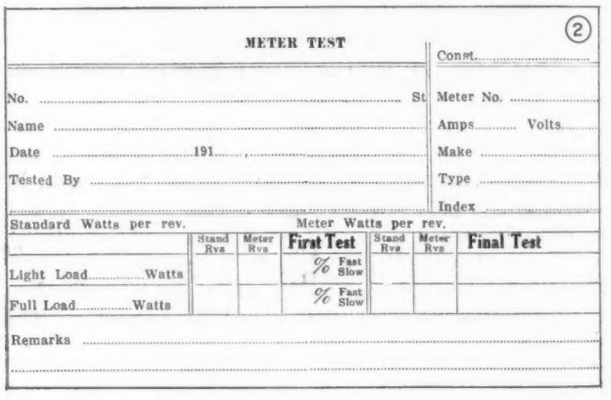
Plans are well in hand for a series of campaigns which should maintain a gradual increase in appliance sales throughout the year so that the entire commercial department's expense can be covered by the profits on the sale of merchandise. This result is rendered doubly sure by the fact that the very war conditions which have increased costs are also rapidly developing an increased market for electrical appliances due to the steadily growing scarcity of servants.

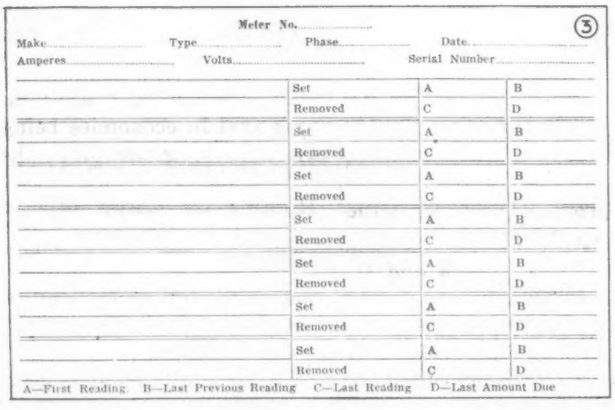
METER RECORDS OF UTILITY IN CITY OF 3000 PEOPLE

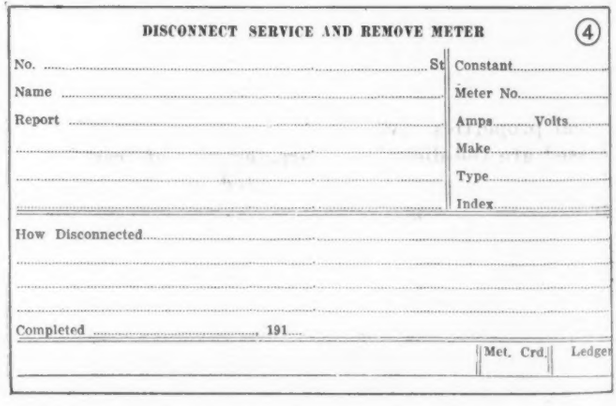
Simple but Complete System of Card Records Used at Beloit, Kan., for Keeping Track of All Service Connections

The light and water department of Beloit, Kan., has a card index system for keeping track of all consumers and their meters. A full set of these cards is reproduced on this page. The service order gives all of the data about the name and location of the customer, the type of service, the meter set and the consumers' load. In addition it carries on the reverse side an account of the time and material chargeable to the job. Every meter is numbered before it is put into service. This is considered good practice because it helps in tracing back through records to identify some previous record or test reading. It also helps identify the plant's property.









FIGS. 1, 2, 3 AND 4—SERVICE ORDER CARD, METER TEST CARD, CONTINUOUS METER RECORD CARD AND DISCONNECT CARD

The meter test card is filed when the job has been executed. A continuous meter record is also kept on another card, a sample of which is shown here. This card serves as a cross index to the service order cards and disconnect cards. These cards are filed numerically according to the meter number, while the other cards are filed according to an alphabetical system hinged on the customers' names. The disconnect cards, which are filed after entry is properly made on the books, carry in addition to the ordinary customer and meter data a statement of how the disconnection was made.

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Windings for Polyphase Motors.—T. SCHUTTER.—Rules for making half-coil and whole-coil windings are given and slot spacing and winding details are embodied in this article, which is illustrated by several drawings.—New York *Electrical Engineering*, April, 1918.

Winding Troubles of Direct-Current Machines.—GORDON FOX.—Methods of locating and temporarily repairing faults of armature and field coil windings are described.—*Railway Electrical Engineer*, April, 1918.

Elementary Principles of Continuous-Current Armature Winding.—F. M. DENTON.—Armature windings are classified as closed-coil and open-coil windings and further subdivided into ring, drum, lap, wave and series parallel windings, single and double re-entrant duplex and multiplex ring windings, and simplex and multiplex wave windings. The different types of windings are illustrated.—London *Electrician*, March 29, 1918.

Economy of Electric Drive in Cane Sugar Mills.—C. A. KELSEY.—Economic advantages that result from adopting electric drive are discussed with respect to labor, supplies, repairs, production, water supply, illumination and traction. The general as well as the specific advantages of electric drive are analyzed, particular attention being given to the direct-current motor-driven centrifugal pumps.—*General Electric Review*, April, 1918.

Essentials of Transformer Practice, Section 11.—E. T. REED.—The author points out that the amount of insulation to be used in a given space often depends upon its mechanical properties and the stresses which it must withstand in winding as well as on other electrical properties involved. Among other subjects discussed are the dielectric characteristics of transformer insulation, curves being presented to show temperature effect, etc.—*Electric Journal*, April, 1918.

Mechanical Design and Specification of Turbo-Alternator Rotors.—S. F. BARCLAY.—Methods of providing for adequate ventilation, the design of end bells, the relative merits of solid and laminated types of rotor, the maximum diameter permissible, factors that should determine the steel used, the design of the shaft and the effect of alternating stresses are among the subjects discussed in this, the last of the author's articles on this subject.—London *Electrician*, March 29, 1918.

Lamps and Lighting

Importance of Correct Lighting in the Shop.—A. L. POWELL.—The factors that influence the amount of light and the equipment necessary to fulfill certain requirements are discussed in this article.—*Railway Electrical Engineer*, April, 1918.

Report on Automobile Headlamps.—Road illumination, the intensity, distribution and direction of light required, the optical principles of headlighting features required in a practical headlamp, safety limitations and the minimum illumination and minimum spread permissible are among the subjects discussed in this report, which includes data and charts.—*Report of Committee on Automobile Headlights*, I. E. S. Council.

Generation, Transmission and Distribution

Russian Water-Power Legislation.—Statistics show that the water-power reserve in Russia is approximately 30,000,000 hp., of which only about 1,000,000 hp. has been utilized. Turbine installations utilize about one-quarter of this amount. Lack of special legislation and the existence of stringent rulings are given as the reasons for this lack of development.—Abstracted from a Petrograd journal by the London *Electrical Review*, Feb. 22, 1918.

Recent Advances in Transmission Construction.—L. M. KLAUBER.—The article deals with improved methods of installing transformers, conductors, splices, spans, poles, cross-arms, braces, insulators, ground guards and dead-end clamps and refers to the latest tendencies as to wire arrangement, clearances and grounding. Embodied in the article is a sag table suitable for stringing conductors. The article is illustrated by several instructive diagrams.—*Journal of Electricity*, March 15, 1918.

Relief of Fuel Consumption.—J. M. ROBERTSON.—The complete and efficient utilization of Canadian resources, including transportation and fuel, as well as the reduction of fuel consumption, by the increased use of hydroelectric energy, are discussed.—*Canadian Engineer*, March 28, 1918.

Power-Plant Losses.—R. J. C. WOOD.—The interconnection of power lines has resulted in economies being effected. A detailed survey of the saving possible in the power plant itself, as well as an analysis of the larger problems, is given in the article.—*Journal of Electricity*, April 1, 1918.

Transmission and Distribution Losses.—R. E. CUNNINGHAM.—War conditions necessitate that electric service be stimulated rather than diminished. The elimination of losses along economic lines is of paramount importance and is dealt with in this article.—*Journal of Electricity*, April 1, 1918.

Power Resources in Southern California.—H. A. BARRE.—The increase of war demand for economical output was met by the power companies of southern California by the interconnection of the hydraulic resources.—*Journal of Electricity*, April 1, 1918.

Installations, Systems and Appliances

Canadian Pumping Stations.—G. KUHNE.—Description of a number of interesting pumping stations installed in Canadian cities. Three of the installations are electric (Port Arthur, Kitchener and Deseronto). The author explains how the problems of speed regulation and water regulation for ordinary and emergency

demands are solved to the satisfaction of these cities.—*Schweizerische Bauzeitung*, Feb. 9, 1918.

Power-Factor Improvement in a Large Central Station.—F. Scoumanne.—An extended study of the actual application of methods of improving power factor previously outlined by the author to the networks of the company at Baku of which he is director. The main divisions of the subject cover the character of the installations and choice of the system; the consequence of raising the power factor and how far it is advantageous; data on interest charges, amortization, price per kilowatt-hour, value of existing installations, and the optimum charge of aerial lines; choice of the centers of production of reactive current, and an elaborate valuation of the economy effected thereby in operating turbo-generators, substations, aerial lines, network, transformers, etc. The determination of the reactive current necessary, the employment of synchronous motors and the use of static condensers are also discussed. The conclusions arrived at are: (1) The improvement of the power factor in the case under study afforded a considerable advantage; (2) on the bases accepted for price, rate of amortization, cost of repairs and production of energy by existing equipment, the static condenser is superior to the synchronous condenser; (3) the optimum value of the power factor is approximately $\cos \Phi = 0.90$, whatever type of condenser is employed. It is better to keep slightly within this value than to go beyond it.—*Revue Générale de l'Electricité*, Feb. 23, 1918.

Tres Sargentos Electric Substation, Buenos Aires.—An unusual feature in this substation is the replacement of reserve batteries by a Diesel-engine-driven generator plant. The article describes the substation in detail.—London *Engineering*, March 22, 1918.

Tendency Toward Outdoor Switching Apparatus.—H. G. MacDonald.—It is pointed out that only recently has it been possible to make large power transformers with all their controlling and protected apparatus so that they can be installed outdoors without protection from the weather. Pressures set up within oil-switch housings by automatic operation under severe overloads must have means of relief, and provision must be made for the escape of gas volatilized from the oil during the summer. If the apparatus is used in cold climates, the oil must be prevented from solidifying. Adequate provision must also be made to protect the mechanism from accumulations of snow and ice. The apparatus must have more mechanical strength than indoor apparatus because severe internal pressures have to be withstood. The insulation of exposed parts must be protected against collection of dirt and moisture and snow. Methods of supporting the switches, providing for inspection, protecting the bushings and operating mechanism are also described.—*Electric Journal*, April, 1918.

Wires, Wiring and Conduits

Iron and Steel Conductors.—R. C. Powell.—The scarcity of copper owing to war conditions has led to the use of iron and steel wherever the substitution is possible. The application of these metals as conductors has created a new situation and problems for the power expert to solve. The situation is analyzed in this article.—*Journal of Electricity*, April 1, 1918.

Electrophysics and Magnetism

Some Applications of Electromagnetic Theory of Matter.—Albert C. Crehore.—The theory of radiation and the atomic structure was principally interpreted from the Rutherford-Bohr theory of the atom. The fundamental hypothesis of atomic structures as composed of electrons, positive and negative, may be considered to be correct. Planck's quantum theory of radiation, the Rutherford-Bohr theory, the electromagnetic theory, rings of electrons, electrons ejected from atoms with high velocity, X-ray spectra, ionizing voltages, theory of crystal structure, atoms at a great distance, the number of electrons per atom, the order of magnitude of the orbits of the electrons in the atoms and several other interesting phases of the subject are set forth in this article.—*Proceedings A. I. E. E.*, April, 1918.

Improvement of Power Factor.—W. C. Rechniewski.—Different methods employed to raise the power factor are discussed. The chief of these are: (1) The employment of high-tension or low-tension static condensers. These have not given practical results because of their fragility, difficulty of regulation, high price, etc. (2) The employment of phase advancers. (3) The employment of over-excited synchronous motors placed in the installations or at particular points of the network to furnish current to the surrounding motors—a plan widely adopted and facilitated by specially constructed motors. The author considers over-excited synchronous motors in two aspects—as producers of wattless current and as producers of motive power. In the first aspect he holds that in the great majority of cases they will pay for themselves in two or three years by the economies realized; from the second point of view they afford the maximum of economy wherever they can be employed. A practical example is worked out to support these conclusions.—*Revue Générale de l'Electricité*, March 9, 1918.

Electrochemistry and Batteries

Methods and Plant for Battery Charging.—F. Ayton.—Different methods of charging lead-plate and nickel-iron alkaline batteries are described and the advantages and disadvantages of a reducing booster plant are discussed. The author concludes by saying that in spite of the higher efficiency and lower cost of the reducing booster it will generally be found, where pressure reduction is required on a scale which justifies the employment of a rotary transforming machine, that the motor-generator is the most satisfactory type to use.—*Electric Vehicle*, March, 1918.

Battery-Charging Equipment of Southern Pacific.—Economies were effected by using a motor-generator set to reduce the generated voltage to a value suitable for charging storage batteries and by employing resistors only to make small adjustments in the voltage. The method of doing this is described and illustrated.—*Railway Electrical Engineer*, April, 1918.

Units, Measurements and Instruments

Experimental Study of Periodical Movements.—A. Poucholle.—Description of an interesting apparatus due to the ingenuity of M. Gueugnon and consisting of an Atwood machine modified for the production and recording of periodical movements, the graphical records lending themselves to precise quantitative measurement.

It will facilitate the comprehension of alternating currents in less advanced schools where the lack of mathematical knowledge makes it necessary to proceed experimentally.—*Revue Générale de l'Electricité*, March 16, 1918.

Chart for Calculating the Resistance of Parallel Conductors.—A. CASTEX.—The chart, based on the method of M. d'Ocagne, provides a convenient means to the end mentioned.—*Revue Générale de l'Electricité*, March 23, 1918.

Telegraphy, Telephony and Signals

Limitations of a Telephone Receiver.—The telephone receiver as a detector for very feeble alternating currents in both wireless telegraphy and wireless telephony is discussed.—*Telegraph Engineer*, April, 1918.

Postal Company's Generator Wiring Arrangement.—A method is illustrated and described for wiring three motor-generators to operate duplexes and quadruplexes. —*Telegraph and Telephone Age*, April 1, 1918.

Simultaneous Telegraph and Telephone Communications.—WILLIAM MAVER, JR.—This article relates to the use of the Van Rysselberthe method of transmitting telegraph messages over metallic telephone circuits without impairing the telephone service. Several wiring diagrams are shown indicating the key system and use of graduators. By this system the emission and extinction of the telegraphic current is rendered gradual, thereby permitting the transmission of telegraphic and telephonic messages over the same line or lines simultaneously by means of a combination of electromagnets and condensers from the graduators by the inventor.—*Telegraph and Telephone Age*, April 16, 1918.

Technical Problems of Radio-Communication.—LÉON BOUTHILLON.—A paper on the application of the Austin-Cohen formula to the determination of the characteristics of sending and receiving radio stations in the calculation of rating, desirable wave length and sending distance. The author arrives at a formula which affords a simple solution of these problems.—*Revue Générale de l'Electricité*, March 23, 1918.

Miscellaneous

Bonus for Power-Plant Employees.—WARREN B. LEWIS.—The author outlines a basis for a bonus system, discussing stand-by losses.—*Power*, March 26, 1918.

Automobile Electric Kitchen.—ANSON S. RICE.—A mobile and entirely self-contained electric kitchen is described. The capabilities of the outfit are demonstrated by results of tests made at the direction of government officials.—*General Electric Review*, April, 1918.

Combustion Characteristics of Coals.—JOSEPH G. WORKER.—Four factors determine the selection of stoker equipment—load conditions, available coal, draft conditions and application conditions. The nature of the load and the amount of coal to be burned by the apparatus are the most important. This is true because different types of stokers can burn the same kind of coal, but each type is limited in the overload rating that can be successfully maintained. The performance data of various stokers burning buckwheat and anthracite coal, Eastern bituminous coal, Pittsburgh coal, low-grade Illinois coal, Illinois and Carterville mixed, lignite, etc., are given. The effect of mixing various percentages of anthracite coal with the ordinary coal used is given in dollars and cents.—*Electric Journal*, April, 1918.

Low-Temperature Industrial Heating.—DWIGHT D. MILLER.—The relative advantages of different types of electric furnaces, their operation and control and the advantages that accrue by the use of electrical energy for production of high temperatures are discussed in this article, which is concluded from the March issue.—*Ohio Electric Light Association Monthly*, April, 1918.

Substitute for Cedar Poles.—L. M. KLAUBER.—War demands on lumber have caused a scarcity of cedar poles. As a result substitutes have been resorted to, the best available substitute on the Pacific coast being Douglas fir, usually termed Oregon pine. Availability, cost, strength and durability are factors to be considered in selecting substitutes, the author points out. A treating plant for fir poles is described.—*Journal of Electricity*, April 15, 1918.

Report of Sub-Committee on Insulation Deterioration.—J. A. KOONTZ.—It is pointed out that the best method of bringing out defects in cap and stud insulators is to subject them to several temperature cycles and test them at suitable intervals for failure due to the formation of cracks in the caps by spark-over voltage. The article includes two tables embodying insulator test data.—*Journal of Electricity*, April 15, 1918.

Possibilities of Reducing Fuel Consumption by the Adoption of Electrical Heating.—P. H. MITCHELL.—The author points out the relative amounts of heat which can be produced for one cent with various fuels and electricity at different prices as follows:

	B.t.u.
Anthracite at $8 per ton	18,000
Anthracite at $10 per ton	14,300
Bituminous coal at $3.50 per ton	48,000
Bituminous coal at $7 per ton	24,000
Peat at $4 per ton	21,000
Fuel oil at 0.07 cent per gal	15,500
Fuel oil at 0.14 cent per gal	7,750
Electricity at 0.01 cent per kw.-hr	3,413
Electricity at 0.008 cent per kw.-hr	4,240

From this he concludes that electric heating is feasible at $12 per horsepower, but that it is not yet an economic possibility, due to high cost and lack of available power. Electric power rates would have to be one-quarter of the present rates for electric heating to compete with heating by anthracite coal. Many millions of horsepower would be required to meet even present requirements. For example, 2,000,000 hp. would have to be available to heat Toronto's dwellings and other buildings, or 4 hp. per capita. When millions of horsepower in Canada are developed and power at $12 is available, a large electric heating load may be established. This, of course, does not mean that every portion of the country could be served, but the great bulk of the population would be within zones of distribution and it might thus be in large degree substituted for coal and other fuels. It may be that the economic use of fuel and water-power resources will demand that fuels shall be reserved for heating purposes and that the hydroelectric power available will be substituted to the maximum for all mechanical, railroad and metallurgical operations. By arranging to maintain a continuous heating load electric heating may be given a positively economic status.—*Canadian Electrical News*, April 15, 1918.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

ELECTROCHEMISTS INSPECT PLANTS IN THE SOUTH

Members and Guests of the American Electrochemical Society Are Making Extensive Tour—F. J. Tone Elected President

One hundred and twenty-five members and guests of the American Electrochemical Society left Washington on Sunday evening, April 28, for a week's trip through the Appalachians south to inspect the electrochemical and metallurgical industries of that region, as well as to study its mineral resources and possibilities of hydroelectric development. The society is traveling by special train chartered with the approval of Director-General McAdoo.

The first stop was at Johnson City, Tenn., on Monday, as breakfast guests of the Chamber of Commerce. Later in the day, at Kingsport, the varied industries of that city were opened to the visitors, who saw the manufacture of cement dyes, explosives, alcohol, paper pulp and tanning extract. The local committee entertained the party at luncheon at Rotherwood Farm. A complimentary banquet in the evening was followed by the annual business meeting, at which the election of officers for the ensuing year was announced as follows:

President, F. J. Tone of the Carborundum Company of Niagara Falls; vice-presidents, Acheson Smith, H. W. Gillett and R. Turnbull; managers, C. F. Burgess, E. L. Crosby and C. G. Schluederberg; treasurer, H. G. Salom; secretary, J. W. Richards.

Tuesday, April 30, was spent in the Knoxville district, with the first stop at Mascot to visit the ore concentration and flotation plant of the American Zinc Company. Later the Knoxville Board of Commerce provided a special train to take the party to the new hydroelectric development of the Aluminum Company of America at Cheoah and Alcoa. At each of these points a 200-ft. (60.9-m.) dam and power house are under construction as the first two units of a complete development of about 400,000 hp. A brief technical session was held in the afternoon at the University of Tennessee.

In the evening a banquet was tendered the visitors, after which President Fink made his presidential address on electrochemistry and national economy. Mr. Schluederberg spoke on the part the United States industries must play to enable the Allies to win the war. Prof. J. A. Switzer of the University of Tennessee gave a report of a preliminary survey of possible water powers in eastern Tennessee. He showed a total possible development of 750,000 hp. at twenty-one sites.

Wednesday, May 1, was spent at Chattanooga and vicinity, visiting plants of the Southern Ferro Alloys Company and the Chattanooga Gas & Coal Products Company. A special trip was made by boat to the Tennessee Power Company's development at Hales Bar. In the evening the society was tendered a dinner at Signalman Inn, which was followed by a short technical session. The rest of the week will be devoted to districts in the vicinity of Muscle Shoals, Birmingham and Anniston, Ala.

SPRING MEETING OF THE CONFERENCE CLUB

National Labor Policy, Government Attitude Toward Contractors and Functional Reorganization of the Industry Discussed at Asheville

The spring meeting of the Conference Club, at Asheville, N. C., on April 25, 26 and 27, was of particular importance for two reasons: Sullivan W. Jones, secretary of the Conference Club, and its representative in Washington, was appointed to represent the National Association of Electrical Contractors and Dealers for the purpose of placing before the government the right claimed by the electrical contracting industry to serve the government in connection with its war construction work. A Conference Club plan for the functional reorganization of the electrical industry was announced.

The regular sessions of the Conference Club were preceded by a meeting of the advisory board of the National Association of Electrical Contractors and Dealers. All of the members of the advisory board are also members of the Conference Club. L. K. Comstock, chairman of the Conference Club, is also chairman of the advisory board. William Creighton Peet, chairman of the national association, outlined the intended function of the advisory board. Mr. Peet's statement was followed by a general discussion of the Washington situation as it relates to government construction work and the employment of the electrical contractor, and also a discussion of the labor problem.

The chairman was authorized to discuss with Mr. McNulty, grand president of the International Brotherhood of Electrical Workers, the possibility of formulating a national labor policy. Back of this authorization was the view, expressed by many of those present, that the labor problem was of the utmost importance to the industry; that the mistake had been made in the past of regarding it as local and intermittent instead of nation-wide and continuous. Organized labor had come to stay, and the time had likewise come to think of the labor question in terms of the future, to look at it down a vista of years, and to formulate a constructive policy acceptable to both employer and employed. It was felt that such a policy need not necessarily be the answer to the sporadic issues arising, but one which would ultimately so alter conditions of employment and relations between the employer and his employees as to provide for the future industrial peace and the maximum of benefits to both.

With respect to the situation on government con-

struction, the discussion developed the consensus of opinion that the electrical contracting industry was at present in a critical position, largely brought about by the government's failure to require general contractors to follow their normal practice of sub-contracting the mechanical and specialized trades. The government's failure in this connection had a very important bearing upon the future of the electrical contracting industry. If the government continued to permit general contractors to create and educate, at the government's expense, branches of their organizations to execute these trades, the electrical contractor might, after the war, find it necessary to go into general contracting to secure his legitimate work. The conclusion was that the work of the secretary in Washington was vital and must be continued. It was pointed out, however, that while he was directing his efforts toward the employment by the government of the whole electrical contracting industry, he represented only the Conference Club. It was decided that in carrying on his work the secretary ought to represent the entire electrical contracting industry.

At the first session of the Conference Club a resolution was introduced and unanimously carried authorizing the advisory board to offer to the national association the services of Mr. Jones as its Washington representative. The offer was accepted by Mr. Peet under authority already vested in him.

The proposed functional reorganization of the electrical industry was presented in a paper in the preparation of which a number of Conference Club members collaborated. After reviewing the defects in the present system for distributing the manufacturers' products and the conflicts between the engineering functions performed by the manufacturer, the contractor and the consulting electrical engineer, the paper proposed a readjustment providing for an orderly sequence of mutually complementary engineering functions in connection with the production, distribution and utilization of the industry products. The proposed plan was summarized as follows:

1. That the manufacturer change and ultimately abandon his practice of selling direct to the ultimate consumer, and abandon also his policy of making such sales on the basis of expert engineering advice given by his representative.

2. That the consulting engineer organize to increase the scope of his practice to include rendering expert services to those large consumers of electrical products who heretofore have been thus served by the manufacturer; that he establish with all manufacturers such relations that he may familiarize himself with their products and standards, advise with them on the improvement of their product, and function as the coordinator of their several departments, and that he cease to function as his client's agent in the purchase of apparatus and supplies.

3. That the electrical contractor reorganize, and annex to his organization engineering talent of a high order, so that he may become a constructing engineer with sufficient capital to act as his own jobber; that he assume much of the consulting engineer's detail work, abandon very largely his independence as a purchaser of the manufacturer's product, and effect with the manufacturer some sort of close working contact based upon a liberal policy providing for reciprocal benefits.

OLIVER HEAVISIDE MADE A. I. E. E. HONORARY MEMBER

Board of Directors Votes to Confer Honor Upon English Mathematician and Physicist for Eminent Services to Science

At a recent meeting of the board of directors of the American Institute of Electrical Engineers in New York Oliver Heaviside, mathematician and physicist, fellow of the Royal Society of London, was elected an honorary member. The vote was unanimous.

This action accorded with the procedure prescribed in the constitution to govern the election of honorary members. It followed the presentation to the board of a proposal in writing, signed by ten prominent members.

In recognition of the eminent services rendered by Heaviside to the scientific world the directors adopted the following resolution:

> **Whereas,** Oliver Heaviside has rendered service of the highest value in the advancement of electrical science, leading to practical results of a far-reaching order, and notably in the development of electromagnetic theory; and
>
> **Whereas,** The constitution of the American Institute of Electrical Engineers provides that by unanimous vote of all the members of the board of directors honorary members may be chosen from among those who have rendered acknowledged eminent services to electrical engineering or to its allied sciences; it is
>
> **Resolved,** That Oliver Heaviside, Fellow Royal Society, London, England, be elected, in recognition of his contributions to electrical science and engineering, to honorary membership in the American Institute of Electrical Engineers.

Oliver Heaviside, now made an honorary member of the A. I. E. E., is, as stated, a fellow of the Royal Society of London. He is an honorary member of the Literary and Philosophical Society of Manchester, a member of the American Academy of Arts and Sciences and an honorary member of the Institution of Electrical Engineers. The University of Göttingen, Germany, conferred the honorary degree of Doctor of Philosophy upon him. The home of Mr. Heaviside is at Homefield, Lower Warberry, Torquay, England.

SHORTAGE OF COAL IS THREATENED NEXT WINTER

National Coal Association Issues Public Statement that Unless Railroad Traffic Is Readjusted Soon Serious Conditions Will Arise

Another coal shortage, more serious than that of last winter, and almost certain interference with the war program are inevitable throughout the East, in the opinion of bituminous coal operators in the chief producing sections of the country, unless there is a readjustment soon of traffic over Eastern railroads. This is stated in a statement made by the National Coal Association. The enormous demands of other war industries are crowding coal off the rails, and the resultant continued shortage of cars at the mines has cut production to the danger point.

WILLIAM D. WEAVER TO BE HONORED BY A. I. E. E. TABLET

Directors of American Institute of Electrical Engineers Accept Petition of Group of Members to Record Appreciation of His Services

A bronze tablet in honor of William D. Weaver of Charlottesville, Va., former editor of the ELECTRICAL WORLD, is to be placed in the room of the board of directors of the American Institute of Electrical Engineers.

A communication to the president and directors of the Institute, presented at the meeting of the board on April 12, follows:

The undersigned members and fellows respectfully submit to the president and the board of directors of the American Institute of Electrical Engineers a petition asking for the acceptance of a permanent record in the form of a bronze tablet, to be placed in the room of the board of directors, in honor of Lieut. William Dixon Weaver, volunteer chief engineer, United States Navy.

The signatories have selected this year since it is twenty years ago that Mr. Weaver, laying aside his work and private duties, re-entered, as volunteer chief engineer, the United States Navy at a moment of the nation's need.

The contemporaries of Mr. Weaver need no explanation of the reason why the signatories desire to do him honor and why they deem the rooms of the Institute the proper place for such record. We have, however, to remember the younger generation.

He was born at Greensburg, Pa., Aug. 30, 1857. He was graduated in 1880 from the United States Naval Academy at Annapolis, studying at the Sorbonne and in London. In 1883 he went on the first Greely relief expedition. He founded the *American Electrician*, and he was editor of the ELECTRICAL WORLD from 1893 to 1912. He re-entered the United States Navy as volunteer chief engineer in 1898. In 1900 he was appointed by the United States government as the official delegate to the International Electrical Congress at Paris, but, upon his suggestion, the appointment was transferred to Dr. Kennelly, who had taken a more active part in the congress work. In 1904 he was treasurer and business manager of the International Electrical Congress at St. Louis.

He was twice a director of the Institute, and from 1901 to 1906 chairman of its library committee. In 1915 he was selected by the board of directors as one of the Institute's representatives on the Naval Consulting Board, but he declined on account of his health.

The Engineering Societies Building owes its existence to the munificence of Mr. Carnegie. At the Institute library dinner in 1903, which Mr. Carnegie attended as guest of honor, Dr. Billings, then perhaps the greatest authority of the world on library administration and organization; Theodore De Vinne, our greatest printer, and R. R. Bowker, who had the leading part in introducing the card catalog, were the principal speakers. In their remarks they referred to the desirability of proper quarters for the great collection of books gathered by the American Institute of Electrical Engineers. Mr. Weaver prepared and submitted to Mr. Carnegie a proposition under which Mr. Carnegie was to donate an amount for the purpose of "housing" the library. Mr. Weaver wished to make this library a great library of reference on electrical, physical, engineering and technical subjects generally, having complete files of important publications, notably the proceedings of the French Academy (donated by C. O. Mailloux) and the proceedings of the Royal Society (donated by E. D. Adams). The library is Mr. Weaver's silent monument.

"But for his extremely retiring disposition," said the ELECTRICAL WORLD of May 4, 1912, "he would long since have been clothed with the highest honors which it is within the power of the profession as a whole to bestow . . . The career of Mr. Weaver is notable . . . also by reason of many other highly important results attained in his characteristic manner, without widespread public knowledge of his work therefor, but always with the assurance on his part that no credit was withheld from all others assisting in the work."

The signatories recognize in him the highest type of an American, engineer, scholar, journalist and patriot, and they desire to dedicate to this Institute, in recognition, always so modestly veiled by him, of his services in the promotion of the welfare of the Institute and the engineering profession; of his untiring assistance and aid to men he deemed able and promising; of the creation of a journalistic forum in which independent opinions could be voiced by all; in rendering those columns familiar to great English, French and other European writers; in having been instrumental, jointly with others, in securing a permanent home for the engineering societies, and in building up the Institute's library and rendering it serviceable to the membership; in organizing and carrying to a successful conclusion the work of the International Electrical Congress at St. Louis and the Commission on Resuscitation from Electric Shock.

We conclude this brief memoir by citing the words of our honorary secretary, Ralph W. Pope:

"The most prominent feature, and which is a matter of record, is his building up of our great engineering library, which was practically accomplished by his exertions, guided by a most remarkable knowledge of engineering literature and his devotion to the highest ideals in the ever-growing field of electrical science."

COMFORT A. ADAMS,
EDWARD D. ADAMS,
BERNARD A. BEHREND,
LOUIS BELL,
ANDRÉ BLONDEL,
EDWARD CALDWELL,
JOHN J. CARTY,
GANO DUNN,
THOMAS A. EDISON,
WILLIAM L. EMMET,
CARL HERING,
F. L. HUTCHINSON,
ARTHUR E. KENNELLY,
C. O. MAILLOUX,
ADDAMS S. MCALLISTER,
RALPH D. MERSHON,
WILLIAM H. ONKEN, JR.,
MICHAEL I. PUPIN,
SAMUEL REBER,
HARRIS J. RYAN,
CHARLES P. STEINMETZ,
NIKOLA TESLA.

In response to this petition the board of directors unanimously adopted the following resolution:

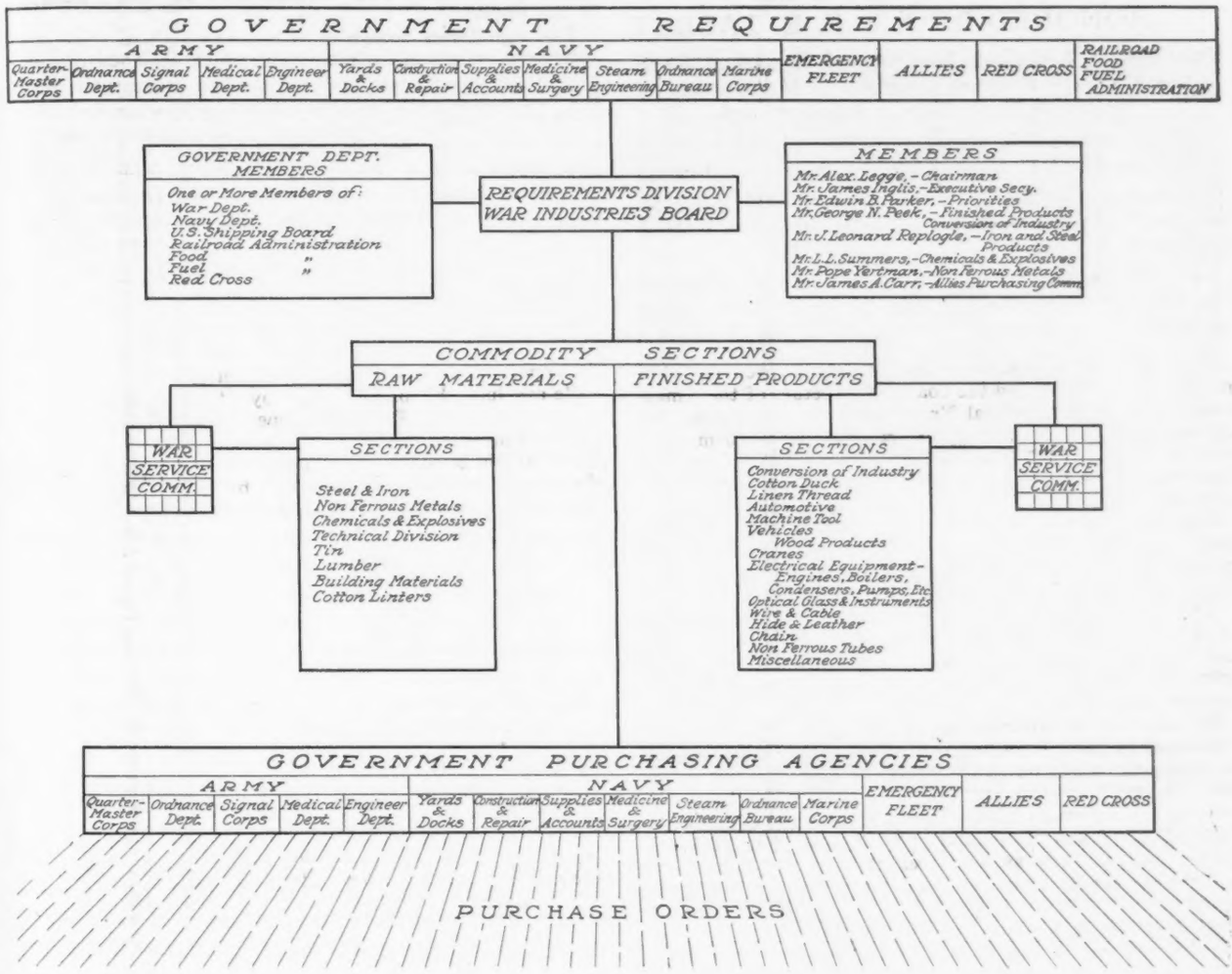
Whereas, A group of members of the Institute has presented a petition to this board offering to donate to the Institute a bronze tablet for the purpose of recording appreciation of the services rendered to the Institute and the electrical engineering profession by William D. Weaver; and

Whereas, Mr. Weaver has been an active member of the Institute for over thirty years and has ably served the Institute in various capacities, including several years as chairman of the library committee and six years as a member of the board of directors; be it

Resolved, That the American Institute of Electrical Engineers hereby accepts the offer referred to above, and that the president be authorized to appoint a committee of three to confer with representatives of the petitioners, this committee to have power to complete the arrangements to carry out the intent of this resolution.

Red Cross Mission Includes Engineers

The American National Red Cross announces that a commission of about sixty, including a number of engineers from the United States, will study existing conditions in Palestine. The commission, with the exception of a few members, is believed to have arrived in Palestine. The following electrical engineers are in the party: Arthur A. Bacon, Hobart College, Geneva, N. Y., and Julius A. Brown, Fayerweather Hall, Columbia University, New York.



ORGANIZATION OF THE REQUIREMENTS DIVISION OF THE WAR INDUSTRIES BOARD

In order to acquire a knowledge of the government's requirements as far in advance as possible this division has been formed, and the various departments of the government and the Allies' Purchasing Commission bring their requirements to it as soon as they are known. These requirements are passed from the requirements division directly to the commodity sections interested in the particular requirements. The diagram was exhibited by George N. Peek at the recent Chicago meeting of the United States Chamber of Commerce.

ENGINEERING COUNCIL ACTS ON INDUSTRIAL EFFICIENCY

Special Committee on Industrial Affairs Drafts Resolution to Urge Retention of Bonus Method of Stimulating Production

The Engineering Council has appointed a special committee on industrial affairs as follows: Prof. George F. Swain, Massachusetts Institute of Technology, chairman; E. W. Rice, Jr., president General Electric Company; Charles T. Main, president American Society of Mechanical Engineers; Alexander C. Humphreys, president Stevens Institute of Technology and Buffalo Gas Company, and Benjamin B. Thayer, vice-president Anaconda Copper Mining Company. The committee has drafted a resolution which was adopted at once by special action of the Engineering Council.

In the preamble of the resolution it is stated that Congress has under consideration in the navy and army appropriation bills proposals to prohibit, diminish and condemn the payment to public employees or to employees of private establishments under government control of any cash reward, premium or bonus for superior service. In the opinion of the Engineering Council these methods, if applied with due regard to wages, surroundings, health and safety of the employee, will increase efficiency and production, help win the war and preserve our institutions. It is vital to the winning of the war, the Engineering Council holds, that no legislation or other measure should be adopted which may interfere with highest efficiency and maximum production; on the contrary, every proper means should be taken to increase efficiency and production.

Upon the subject matter of the resolutions presented on April 18 by F. P. Fish, chairman of the National Industrial Conference Board, the special committee is now concentrating its attention and making a careful investigation. This board has requested the engineering societies of the United States "to investigate and to publicly express themselves as to whether or not we are losing or gaining in industrial efficiency, and to state what causes, if any, in their opinion are influencing the condition, and in what manner broadly they believe our industrial efficiency can be stimulated."

The A. I. E. Members in Service

A framed poster hanging on the wall of the offices of the American Institute of Electrical Engineers, New York, tells the present total.

EDISON MEDAL AWARDED TO COL. JOHN J. CARTY

Presentation of Eighth Edison Medal for Colonel Carty's Work in Science and Art of Telephone Engineering to Be on May 17

The eighth Edison medal has been awarded by the Edison medal committee of the American Institute of Electrical Engineers to Col. John Joseph Carty for his work in the science and art of telephone engineering.

The medal will be presented to Colonel Carty at the annual meeting of the Institute to be held in the auditorium of the Engineering Societies Building, New York, Friday, May 17, at 8.30 p. m. President E. W. Rice, Jr., will preside and the program will be as follows: Address by A. E. Kennelly outlining the origin and purpose of the Edison medal; address by Michael I. Pupin giving history of Colonel Carty's work in regard to telephone engineering; presentation of medal to Colonel Carty by President E. W. Rice, Jr.; acceptance of the medal by Colonel Carty.

As is generally known, the Edison medal was established upon the initiative of a group of friends and associates of Thomas A. Edison for the purpose of recounting and celebrating the achievements of a quarter of a century in the art of electric lighting with which the name of Edison is imperishably identified. It was decided that the most effective means of accomplishing this object would be by the establishment of a gold medal which should, during the centuries to come, serve as an honorable incentive to scientists, engineers and artisans to maintain by their works a high standard of accomplishment.

Therefore the Edison medal was established and endowed with a trust fund, under an indenture dated Feb. 11, 1904, whereby the American Institute of Electrical Engineers agreed to award the medal annually. The medal is awarded each year, by a committee consisting of twenty-four members of the Institute, to a resident of the United States of America and its dependencies or of the Dominion of Canada, "for meritorious achievement in electrical science or electrical engineering or the electrical arts."

POWER CONTRACT TERMS MADE IN PASADENA, CAL.

Agreement, Subject to Approval of State Railroad Commission, Arranged Between City and Southern California Edison Company

After lengthy negotiations between the Southern California Edison Company and the city of Pasadena, an agreement has finally been reached which is satisfactory to both, and essentially along the lines of elimination of duplicate investment and conservation of fuel resources. The agreement is subject to the approval of the Railroad Commission of California, and a joint application was made to the commission by the city and the Edison company at a hearing held in Los Angeles on April 25. The following are the principal points covered by the agreement:

The city of Pasadena agrees to lease the electric distributing system of the Edison company in Pasadena, the stipulated value of which is $513,102.11, for a period of two years, the city to pay a rental for said property equal to 8 per cent per annum and also to pay rental for the use of every extension made to the company's distributing system in Pasadena at the same rate. In addition, the city agrees to pay to the company an amount equal to 3.36 per cent of the value of the company's distributing system on account of depreciation, the money so paid to go into a depreciation reserve fund, which will be handled according to a special provision in the agreement.

The city is to have an option to purchase the company's distributing system in Pasadena at the price stipulated plus cost of additions thereto at the end of the two-year period. If the war still continues at the end of two years, then the lease may be extended under the same terms and conditions until the end of the war and for four months thereafter.

The city agrees to purchase from the company at all times during the term of the lease such electrical energy as it may require, and at the termination of the lease, provided that the city acquires the company's distributing system, to continue purchasing all its electrical energy from the company until April 15, 1933.

The schedule for energy supplied by the company to the city is to be: For the first 250,000 kw.-hr. furnished during each month, 0.95 cent per kilowatt-hour; for the next 500,000 kw.-hr. furnished during each month, 0.90 cent per kilowatt-hour; for all over 750,000 kw.-hr. furnished during each month, 0.75 cent per kilowatt-hour.

The city is to have the right, upon giving thirty days' notice, to take service upon an annual load-factor basis,

the load factor being figured upon an average of the three highest peaks in a year, no two peaks being in any one month. The load-factor schedule is:

	Cents per Kw.-hr.
Less than 44 per cent load factor	0.875
Less than 46 per cent but not less than 44 per cent.	0.85
Less than 48 per cent but not less than 46 per cent.	0.84
Less than 50 per cent but not less than 48 per cent.	0.82
Less than 52 per cent but not less than 50 per cent.	0.79
Less than 54 per cent but not less than 52 per cent.	0.77
Fifty-four per cent and over	0.75

The steam plant of the city, with a rating of 6000 kw., which now supplies electrical energy to the city's distributing system, shall be maintained by the city and kept in condition for operation, but shall be operated only upon the order of the company or when and during the time the service of the company to the city shall be interrupted and the operation of the plant reasonably necessary. Whenever the plant shall be operated the company is to pay all costs incident to putting it in operation and maintaining it during the period required, including interest and depreciation at the rate of 12 per cent per annum for said period on the depreciated value of the plant as carried upon the books of the city.

During the period of the lease the provisions of the agreement will be carried out under the supervision of an "operating board," to consist of the manager of the city's electric department and a representative of the company.

The city agrees to lease and sell to the Edison company certain distribution lines belonging to the city outside the limits of Pasadena under the same terms and conditions as the Edison company's lines in Pasadena will be leased or sold to the city, and further agrees to confine its electric distributing business in future to the territory within the corporate limits of Pasadena, certain specified existing consumers outside the city excepted.

During the term of the lease all additions and new business secured by the city shall be attached to and become a part of the respective systems of the city and the company in such manner and quantity that the new business and extensions measured in income shall be so distributed that the present proportion of business as between the company and the city shall be at all times substantially maintained. The distribution of such extensions and new business shall be subject to the operating board. The present proportion between the city's business and the company's business is determined as 56 to 44.

The testimony submitted at the hearing before the commission indicated that Pasadena could make great economies in operation by the consolidation of the Edison company's Pasadena business with that of the city. No rate reductions were promised by the city in the near future. The Edison company will be a gainer by the agreement in that it will earn 8 per cent on its local investment instead of less than 5 per cent under existing conditions, and that it will supply a total of over 12,000,000 kw.-hr. annually to the territory within the city, instead of approximately 5,000,000 kw.-hr. as at present.

Since December, 1917, the city of Los Angeles has been supplying Pasadena with some electrical energy, this being surplus energy from the aqueduct plant over and above that required by Los Angeles under its contract with the Edison company. At the hearing before the Railroad Commission in reference to the joint application of the city of Pasadena and the Edison company, the city attorney of Los Angeles entered a protest against the discontinuance of power service to Pasadena by Los Angeles which would follow the approval of the joint application made by Pasadena and the Southern California Edison Company. The existing contract between Los Angeles and Pasadena for surplus electrical energy contains a provision that it may be abrogated upon thirty days' notice by either. According to the attorney for Los Angeles, the protest was made along the lines of patriotic conservation. He stated that Los Angeles did not desire to embarrass Pasadena in the matter of its agreement with the Edison company, but that if the power service of Los Angeles city to Pasadena were discontinued, the Edison company would have to supply an equal amount of energy generated by steam. This statement was not allowed to go unchallenged by representatives of the Edison company.

PROBLEMS OF WAR BEFORE OKLAHOMA ASSOCIATION

Meeting of 200 at Oklahoma City Marked by Seriousness and Patriotic Consideration of War-Time Questions

The seventh annual convention of the Oklahoma Gas, Electric and Street Railway Association was held in Oklahoma City on April 22, 23 and 24. About 200 utility representatives were in attendance. The convention was marked by an attitude of seriousness not noted in previous conventions. The utility members seemed to feel that the present conditions called for co-operative work, for patriotic willingness to share their portion of the war burdens and for an entire revision of the past methods in dealing with the public. The association at this convention accomplished more in the way of reaching a solution of the larger utility questions than at any convention in the previous history of the association.

The first session met on Monday afternoon. Mayor Overholser of Oklahoma City made an address of welcome, and F. D. Shaffer, manager of the Chickasha Gas & Electric Company, gave his presidential address, the keynote of which was co-operation on the part of the utilities of the State to relieve the present financial stringency and effectually prosecute the war.

C. W. Shannon read a paper on "The Reliability of the Oklahoma Oil and Gas Fields." Mr. Shannon predicted that in the near future it would be possible to predetermine the life of Oklahoma oil and gas wells. The convention then adjourned to inspect the new waterworks project built for the supply of Oklahoma City at a cost of $1,500,000.

At the Tuesday morning session L. E. Mohrhardt read a paper on the use of electricity in the oil and gas fields of the State. Discussion brought out the point that the load obtainable in the oil and gas fields would be advantageous to central-station men from every standpoint, but that there had been no attempt to get this load. One of the difficulties is the necessity for costly equipment and high-tension lines. Mr. Barnes of the Westinghouse Electric & Manufacturing

Marching for the Third Liberty Loan in New York City

Executives and employees of the New York Edison Company, the United Electric Light & Power Company and affiliated companies turned out for the Liberty Day parade, April 26, swelling the numbers and adding to the enthusiasm.

Company said that the oil-well supply firms have volunteered to carry a stock of electrical apparatus, thereby lowering the capital investment of the central stations.

After hearing the papers of Guy B. Treat, chief engineer of the Oklahoma Railways Company, and Prof. L. W. W. Morrow of the University of Oklahoma, the convention went on record in support of the National Committee on Public Utility Conditions appointed by the National Electric Light Association, the American Gas Institute, the National Commercial Gas Association and the American Electric Railway Association. It passed a resolution to the effect that the Oklahoma sub-committee of the national committee be empowered to engage a high-grade man to handle the work of the associations in Oklahoma in connection with the granting of rate increases, the obtaining of financial aid from the War Finance Corporation and the obtaining of proper publicity for the utilities in the State, and in other ways to advance the interests and promote the welfare of the individual members of the association.

In discussing the papers, the consensus of opinion was that a rate increase was the only solution of present financial problems, and that such an increase ought to be granted upon proper presentation of facts with a minimum delay.

At the afternoon session C. S. Thompson and J. W. Shartel discussed the advisability of concentrated production, transmission and distribution of electricity in Oklahoma through the use of a few large stations.

The discussion of the paper by L. A. White, entitled "Gas-Fired Boilers," dwelt on the fact that a large combustion chamber was the essential prerequisite for the efficient use of gas under boilers. Mr. Kretz of Okmulgee went so far as to advocate the Dutch oven method of combustion. Mr. Molinard of the Oklahoma Gas & Electric Company said that his company was now trying out the effect of large and small combustion chambers on oil-fired boilers. The opinion prevailed that the use of gas for power production was a thing of the past and that every plant must necessarily be equipped with oil or coal for emergency conditions when the gas supply was low or completely failed.

At the Wednesday morning session the discussion following Charles Hoopes' talk was to the effect that the licensing of stationary engineers was advisable in Oklahoma, and a resolution favoring a law to this effect was passed.

In discussing Prof. F. F. Blachly's paper on "Utility Taxation" there was no agreement as to a proper method of taxation, but there was an entire agreement as to the advisability of an intensive study of the subject with a view to working out an equitable basis for Oklahoma.

At the afternoon session there was a thorough discussion on the relations of the utilities and the consumer. The idea advanced by A. L. Mitchell was that every utility should be represented in an association and at its meetings, and that the meetings of such an association afforded the only place for the utilities and the corporation commission to discuss informally the many utility problems. The opinion of the members was that commission regulation had come to stay and that so long as the standard of the Oklahoma commission membership was maintained there could be no more advisable method. J. C. Resler, city manager at Weatherford, advocated the placing of municipal plants under the jurisdiction of the corporation commission in order to enforce proper accounting methods.

J. F. Owens, vice-president and general manager Oklahoma Gas & Electric Company, was elected president; C. S. Thompson, general manager Shawnee Gas & Electric Company, first vice-president; J. W. Shartel, vice-president and general manager Oklahoma Railways, vice-president, and L. W. W. Morrow, University of Oklahoma, secretary-treasurer.

Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 963 of this number.

Duluth Engineers' Joint Meeting.—There will be a joint meeting of all the engineering societies in Duluth on May 20. General subjects will be discussed.

Institute of Radio Engineers.—"The Feasibility of Low Antennas in Radio Telegraphy" was the title of a paper presented by Prof. Edward Bennett of the University of Wisconsin before the Institute of Radio Engineers on May 1.

A. I. E. E., Panama Section.—On April 21 the Panama Section of the American Institute of Electrical Engineers held a meeting at Balboa Heights. E. A. Graham, electrical engineer, presented some general notes on methods used in public utility examinations.

National Fire Protection Association.—On May 7, 8 and 9 the National Fire Protection Association will hold its twenty-second annual meeting at Chicago in the auditorium of the Insurance Exchange Building. The report of the electrical committee will be given during the Tuesday morning session, which opens at 10 o'clock.

N. E. L. A., Southeastern Section.—The Southeastern Section of the National Electric Light Association will hold its annual convention on June 19 and 20 in Atlanta, Ga. The meeting will be a strictly war-time meeting and no provision will be made for entertainments. The titles of the papers and other details will be given later.

Syracuse Technology Club.—Prof. A. R. Acheson, consulting engineer of the Bureau of Gas and Electricity, presented some thoughts regarding street lighting in Syracuse, N. Y., before the Technology Club on April 22. He discussed several methods for lighting the down-town districts in the town, methods for assessment for the special lighting and a new method of lighting residential districts.

A. S. C. E., San Francisco Section.—That water-power development is to be fostered was the prediction of F. H. Fowler, United States Forestry Engineer, before the San Francisco Section of the American Society of Civil Engineers on April 16. "Demand for power in California has been increasing at a steady rate of about 30,000 kw. mean load annually," said Mr. Fowler, "and this means that there should be an annual installation of from 40,000 kw. to 50,000 kw. to carry the peak loads." He also stated that there was a shortage in development which could be attributed to two causes, first, the uncertainty concerning federal legislation, and second, the failure of rate-fixing bodies throughout the country to allow increases in rates as rapidly as the cost of production increased.

A. I. E. E., Spokane Section.—"Hydraulic Turbines—Their Design, Manufacture, Efficiency and Testing," was the subject of a paper by J. W. Hungate, electrical superintendent Inland Empire Railway Company, C. F. Udhen, chief engineer Washington Water Power Company, and R. F. Daniels, engineer Washington Water Power Company, presented before the Spokane Section of the American Institute of Electrical Engineers on April 19.

A. E. R. A. Annual Convention.—The annual convention of the American Electric Railway Association and affiliated associations will be held at Atlantic City, N. J., this year during the second week in October. According to the tentative program so far prepared, the American association meeting will open on Tuesday afternoon, Oct. 8, and close on Wednesday afternoon. The affiliated associations will meet on Wednesday and Thursday mornings.

Boston Engineers.—The ninth annual dinner of the Boston Society of Civil Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers was held at the Boston City Club on April 30. W. H. Blood, Jr., of the American International Shipbuilding Corporation spoke on "The Greatest Shipyard in the World." Alfred D. Flynn, secretary of the Engineering Council, talked about the progress and changes of that body.

American Gear Manufacturers' Association.—The second annual meeting of the American Gear Manufacturers' Association was held April 18 to 20 at White Sulphur Springs, West Va. F. N. Sheppard of the United States Chamber of Commerce spoke at the opening session on "How We Can Get Behind the Government and Help Win the War." F. W. Sinram was elected president, and Frank D. Hamlin was chosen for secretary and treasurer. The next meeting of the association will be held in September, the time and place to be determined later.

Pacific Coast Joint Electrical Meeting.—The meeting of all of the electrical interests on the Pacific Coast will be held in Del Monte, Cal., as previously announced in the ELECTRICAL WORLD. The National Electric Supply Jobbers of the Pacific Coast will meet on Monday, May 6, the California Association of Electrical Contractors and Dealers will convene on Tuesday, and the delegates of the National Electric Light Association will arrive on Thursday. Some of the important papers to be presented are: "Possible Water-Power Development in California," by F. H. Fowler; "Joint Operation of Power Companies," by J. P. Jollyman; "Power-Plant Losses," by R. J. C. Wood; "Transmission and Distribution Losses," by R. E. Cunningham; "Iron and Steel Conductors," by R. C. Powell; "Standardization of Pin-Type Insulators," by L. M. Klauber and R. E. Cunningham; "Substitute for Cedar Poles," by L. M. Klauber, and "Insulator Deterioration," by J. A. Koontz. There will also be papers on commercial, accounting and contractors' problems.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Pole Maintenance.—Where the employee of a telephone company, in order to make certain repairs, climbed a telephone pole and sustained injuries as a result of the breaking of the pole beneath the surface of the ground on account of its decayed condition, which condition was not obvious or known to him, it being shown that it was not the duty of the employee under his contract of employment to make an independent inspection of the pole for the purpose of discovering hidden defects, the failure of the telephone company to use due care to maintain such pole in a reasonably safe condition for the purpose of such employment constitutes actionable negligence, the Supreme Court of Idaho held (170 P. 88).

Liability of Water-Power Company for Damages Caused by Dam on Navigable River.—The erection of a dam in the Tennessee River, backing water over lands adjacent to those occupied by plaintiff as tenant at will, was an appropriation for flowage purposes, all resulting damages from which were compensated by an award to the owner, plaintiff's landlord, the Supreme Court of Tennessee held in Chattanooga & Tennessee River Power Company vs. Lawson (201 S. W. 165). A private contractor building a dam to be deeded to the United States in a navigable stream under direction and according to specification of the United States is liable only to the same extent as the government, which is not liable for the consequential damages to a tenant at will of one who has been compensated for land taken by alternate overflow and recession of water, causing stagnation and breeding mosquitoes which infected plaintiff and his family with malaria. Such contractor, being liable only to the same extent as the government, it is not liable for the tort of failing to remove obstructions and rubbish after each overflow, since the United States is not liable for torts. Where a dam was erected for the United States in a navigable stream and alternate overflow and recession caused a stagnant pool on land of a private owner, the United States was not liable for failure to drain the pool, since it had no right to go upon private lands for such purpose. That a private contractor building a dam to be deeded to the United States in a navigable stream under direction and according to specifications of the United States retained an interest in the surplus water for power production did not render the contractor liable for merely consequential damages to residents of the vicinity by reason of creation of unhealthful conditions.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Government Wants Men for Export-Trade Offices.—The government is looking for men capable of taking charge of branch offices of the Bureau of Foreign and Domestic Commerce, Department of Commerce; also men to act as assistants in such offices. These branch offices are established in the principal commercial cities, the salaries ranging from $1,800 to $3,000 for managers and from $1,200 to $1,800 for assistants. Applicants should write at once to the Bureau of Foreign and Domestic Commerce at Washington, as a non-competitive examination will be held on May 16 in various parts of the country.

University of Pittsburgh Gives Radio Engineering Course.—A course in radio engineering for technical graduates will be given at the University of Pittsburgh, starting May 20 and lasting for eight weeks. This course will be open only to graduates in electrical or mechanical engineering who are recorded in class 1 of the National Army draft. Men enrolling in it will be placed by the government in class 5 until completion of the course, when they will be inducted into the Signal Corps and sent to an army school for further training. The need for men familiar with the technique of radio communication is great, and the chances for obtaining a commission ultimately are good. There will be no charge for tuition, but students must provide their own living and traveling expenses. As the number of men is limited, application should be made at once to Prof. H. E. Dyche, department of electrical engineering, University of Pittsburgh, Pittsburgh, Pa.

National War Labor Board.—The National War Labor Board, the outgrowth of the Commission of Employers and Workers, has mapped out a plan of organization. Frank P. Walsh of Kansas City and William H. Taft, who had been designated by the President as chairmen of the board, will preside alternately at all sessions. The board, as finally appointed by the President, consists of the same persons who formulated the national war labor program, but pending the return of William H. Johnson, president International Association of Machinists, now abroad upon a special mission, his place will be taken by T. J. Savage. The other members are: Loyall A. Osborne, vice-president Westinghouse Electric & Manufacturing Company; B. L. Worden, vice-president and general manager Submarine Boat Corporation; W. H. Van Dervoort, vice-president Root & Van Dervoort Engineering Company; L. F. Loree, president Delaware & Hudson Company, and C. E. Michael, president Virginia Bridge & Iron Company, representatives of employers, and Frank J. Hayes, president United Mine Workers of America; William L. Hutcheson, president United Brotherhood of Carpenters and Joiners of America; Victor Olander, secretary Illinois State Federation of Labor, and T. A. Rickert, president United Garment Workers of America, representatives of employees.

Employment Management.—The first course of intensive training in employment management under government supervision has been opened at the University of Rochester. Twenty prospective employment managers, sent by manufacturers having war contracts, including especially shipbuilding plants and several departments at Washington, have begun six weeks' intensive training in the practice and theory of employment management. The course is given at the request and under the supervision of the industrial service sections of several departments at Washington. It will later be repeated in Boston, New York and elsewhere.

Dividends in Scrip.—American Public Utilities Company directors declared the regular quarterly preferred dividend due on April 1 in scrip, payable on or before April 1, 1923, with 6 per cent interest, payable semi-annually. The directors deemed it prudent to conserve the cash resources of the company and its subsidiaries. While not authorizing any unusual construction expenditures by subsidiary companies, at the same time the directors felt that they must provide for the constant demands for added service at existing plants, and as there is no certainty that funds for these unavoidable expenditures can be obtained through the sale of securities in the usual way, they must be taken from earnings ordinarily devoted to dividends.

Vail Expects Justice for Telephone Company.—In a statement at the annual meeting of shareholders of the American Telephone & Telegraph Company, Theodore N. Vail, the president, said: "The system must be increased as fast as demands of a growing country call for service and as fast as new services are discovered and introduced. Whenever our earnings are in excess of requirements, if they are not absorbed by improvements in service, they are invested in plant, which is not burdened with capital charges and which thus forms a safeguard against possible obsolescence on a large scale. These commitments make necessary readjustments in charges, and while we have had many reductions, we have been obliged to ask many rate increases. After a thorough presentation of our case, we have never been refused relief, with the possible exception of some negligible cases. We have been allowed many increases in rates in many cases the last year, and there are several very important cases closing in which we have had most favorable consideration and in which material increases are conceded. We feel confident that we shall continue to get ample justice and full consideration."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Electric Extensions During the War.—The California Railroad Commission has authorized the Mount Whitney Power & Electric Company, which sells electricity in Tulare, Kern and Kings Counties, to put into force certain rules for extensions of electric service during the war. These rules obligate the company at its own expense to make all extensions in which the annual gross revenue equals a third of the cost. Where the annual gross revenue is less than the cost of the extension, but more than one-fifth, the company will give the service if the consumer advances the entire cost, which will be refunded to him on the basis of 20 per cent of the monthly bills. The consumer may at his own cost build enough of the extension so that the amount to be expended by the company shall not be more than three times the annual payment for service by the consumer. The Mount Whitney company is ordered to adjust all extensions made by it within one year prior to this order, if requested by the consumer.

Rate Relief in Wisconsin.—A decision of the Wisconsin Railroad Commission authorizing the Glidden Light, Power & Water Company to increase electric rates says in part: "There is bound to be more or less fluctuation in voltage with equipment such as that used at Glidden, but the commission does not believe that conditions at this time warrant the issuance of an order requiring the utility, in view of its finances and in view of the present high prices of apparatus, to go to the expense of installing auxiliary equipment so that absolutely uninterrupted service may be rendered. . . . It is evident that some adjustment of the rates is necessary to give the utility relief. . . . If the flat rate for business use as filed were strictly applied the increase would be greater. Inasmuch as the practice of supplying electric service to commercial users on a flat-rate basis, except under certain restricted circumstances, is contrary to the best accepted practice in electric plant operation, the commission has endeavored to eliminate such flat rates whenever possible. In the present case the finances of the utility do not warrant the purchase and installation of meters upon all flat-rate consumers at this time. We believe, however, that the flat rates should be increased and, further, that steps should be taken by the utility so that flat-rate users who desire to be metered may purchase the meters at cost from the utility, the latter to refund 50 cents monthly to each such consumer until the amount paid has been returned to him."

Men of the Industry

Changes in Personnel and Position—Biographical Notes

G. H. Smart, commercial manager of the Knoxville (Tenn.) Railway & Light Company, has resigned.

Ivy Carr has succeeded **F. H. Miller** as manager of the Crawfordsville (Ind.) Electric Light & Power Company.

George M. Patterson has been appointed manager for the Central Maine Power Company at Bucksport, Me.

William H. Fitzhugh, superintendent of the Bay City (Mich.) electric light department from November, 1885, to the present time, has resigned.

John D. Ryan, president of the Anaconda Copper Mining Company and of the Montana Power Company, has been appointed director of aircraft production for the army.

Dr. A. E. Kennelly, professor of electrical engineering at the Massachusetts Institute of Technology, has been appointed acting head of the electrical engineering department of the Institute during the absence of Professor Jackson, who has been commissioned a major.

Frank V. Burton has been appointed to the newly established position of general sales manager of the Bryant Electric Company of Bridgeport, Conn. He was educated in the public schools of Albany, N. Y., and in 1891, at the age of seventeen, in partnership with his brother, embarked in an electrical contracting business which continued about three years. He entered the electrical contracting firm of Berger, Rogers & Potter of Troy, N. Y., and in 1895 became connected with the Western Electric Company at New York, first in the construction department and later in the supply department, where he remained for more than six years. A short connection with the electrical engineering firm of Sanderson & Porter of New York followed, and in the summer of 1902 Mr. Burton entered the employ of the Bryant Electric Company, where he has remained ever since, first as service correspondent, in 1907 as Eastern sales manager and now as general sales manager. Mr. Burton is active in several of the sections of the Associated Manufacturers of Electrical Supplies.

F. V. BURTON

W. W. Erwin has been appointed chief operating engineer of the New York Edison Company to succeed the late J. P. Sparrow. Mr. Erwin joined the forces of the Edison company in October, 1900, as a mechanical draftsman. He was made chief draftsman in 1903 and superintendent of construction in 1906, which position he held until his appointment to the present one.

W. W ERWIN

Lieut. William Sikes Tucker, formerly connected with the sales department of the Electric Storage Battery Company, Philadelphia, has been awarded the French war cross for bravery.

F. W. Lachicotte, Jr., manager of the Chester (S. C.) branch of the Southern Public Utilities Company, has been transferred to become superintendent of the electrical department of the Charlotte (N. C.) branch of the company.

Frank L. Fox, for the last four years manager of the Thomasville (S. C.) branch of the Southern Public Utilities Company, has been transferred to the managership of the Chester (N. C.) branch, succeeding F. W. Lachicotte, Jr.

W. W. Hanks, superintendent of the electrical department of the Charlotte (N. C.) branch of the Southern Public Utilities Company, has resigned to become associated with the Charlotte Electric Repair Company, in which he is interested.

H. W. King, superintendent of distribution for the East St. Louis Light & Power Company, has resigned that position to become associated with the Sangamo Electric Company of Springfield, Ill. A farewell banquet was given him at the Planters' Hotel in St. Louis by the St. Louis Electric Club.

G. N. Turner was recently appointed manager of the Washington-Idaho Water, Light & Power Company at Castle Rock, Wash., succeeding H. A. Bottomly.

Cyrus Schumacher, for the last ten years superintendent of the Bluffton (Ohio) Light and Water Works, has resigned to go into the business of manufacturing air motors.

R. C. Coffy, formerly manager of the Puget Sound Gas Company, Everett, Wash., will succeed George H. Wilmarth as manager of the Sapulpa (Okla.) Electric Company.

George H. Wilmarth, formerly manager of the Sapulpa (Okla.) Electric Company, has been appointed manager of the Muskogee Gas & Electric Company, Muskogee, Okla., succeeding J. F. Owens, who has been promoted.

Prof. Dugald C. Jackson, the head of the department of electrical engineering of the Massachusetts Institute of Technology, has received the commission of major in the Engineers' Reserve Corps and has been ordered to France. Major Jackson began his educational work as professor of electrical engineering at the University of Wisconsin, where he stayed from 1891 till 1907, when he was called to the Massachusetts Institute of Technology to fill the chair of electrical engineering. In the same year he was named in charge of the department at the Institute, a position which he still retains. In 1913 he became in addition a member of the staff of the electrical engineering research laboratory. This laboratory led to the establishment at the institute in 1917 of a division of electrical research, of which he was one of the directors. Major Jackson has been president of the American Institute of Electrical Engineers and of the Society for the Promotion of Engineering Education and a member of other national associations, the American Society of Civil Engineers and the American Society of Mechanical Engineers, also of the English Institution of Electrical Engineers and the Société Internationale des Electriciens. He has contributed largely to the literature of electrical engineering.

D. C. JACKSON

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

FILLING OF STEEL ORDERS ON PRIVATE ACCOUNT HELD UP

Facilities of Mills and Blast Furnaces Devoted Solely to Government Requirements for Thirty Days

At a meeting of fifty iron and steel manufacturers held in New York City April 26, after a conference with government officials, it was decided to hold in abeyance practically all orders for commercial steel. By this action the heads of the industry engaged to put their entire plants at the disposal of the United States and the allied governments for the production of material for the munition factories and shipyards, thereby sidetracking indefinitely contracts entered into with private buyers. Therefore manufacturers of electrical apparatus, machinery, supplies, accessories and a long line of specialties and staples for which steel is essential, unless requirements have been anticipated and sufficient stock is on hand to meet the demand, will be obliged to curtail or defer production and postpone promised deliveries.

Exceptions from this program, it is understood, will be only those buyers of commercial steel who secure government authorization for the early completion of their orders. The initial steps in this schedule for concentration were taken several weeks ago, when a number of companies decided to shelve for thirty days all commercial orders.

Furthermore, a fresh survey of steel consumption throughout the country made by the government requires that each seller of steel be told by his customer or the buyer the precise use to which steel already ordered is to be put. All tonnage either on government or civilian orders is to be so itemized. The various rulings that have been made as to priorities in manufacture and shipment are to be elaborated, so that in substance there will be a definite sequence all along the line, the lesser essential commodities to be placed nearer the bottom of the list

PRODUCERS AND DISTRIBUTERS MARK UP WEATHERPROOF WIRE

Increasing Cost of Cotton Is the Cause—Scarcity of Tin May Affect the Rubber-Covered Product

Weatherproof wire has responded to the increasing cost of cotton by an advance of from 1 cent to 2 cents a pound recently. Cotton has more than doubled in cost within a year, and therefore weatherproof manufacturers feel justified in adding their extra expense to the finished article. In fact, the cost of production has steadily been going up fractionally for some time. Jute, which is used as an insulating material on copper cable, is also high and difficult to obtain, and a revision of quotations may be made on the finished product.

A difference of figures is noted as between various producers. One large company, selling in quantities, quotes 26½ cents a pound for weatherproof, declaring that no change in price has occurred for several months. A second manufacturing concern of equal standing, which specializes on power-house orders, quotes from 25 cents to 26 cents, and states that it is glad to handle all business it can get at that figure. With 23½ cents as the government price on raw copper the concern says it finds ample margin in such transactions. A third firm, which also sells almost exclusively to power houses, confessed it was high in naming 27½ cents.

Jobbers estimate their requirements on a 30-cent base, the ELECTRICAL WORLD quoting weatherproof in 100-lb. lots, New York, 28¼ to 34¼ cents; Chicago, 33.42 to 38.35 cents, which has ruled for some time. Jobbing houses accept these prices, but it is probable that an order of some size may be booked on a closer figure. One prominent distributer has notified the trade of an advance of 2 cents a pound.

Rubber-covered wire, on account of the unprecedented cost of tin, may also be subjected to a revision if the metal goes much higher. This week Straits tin cannot be bought at any price, and it is nominally quoted at $1 a pound, with a possibility of $1.50 next month. Chinese tin, which is not so pure as Straits, containing a greater percentage of arsenic, but answering perfectly for coating bare copper wire for rubber covering, sold at 92 cents, May arrival.

FUEL ORDER BRINGS ECONOMY IN WASHING-MACHINE INDUSTRY

Idea That Savings Would Need to Be Made or Output Curtailed Stimulated Manufacturers to Renewed Efforts to Increase Efficiency

According to a report issued from the American Washing Machine Manufacturers' Association, the industry operated under restrictions in accordance with its pledge and the fuel order for the month of January, 1918. The monthly reports from members in practically every case showed that the manufacturers practiced the economies to which they had pledged themselves without decreasing their volume of production, except as such a decrease was caused by the Garfield holidays and the lack of transportation facilities. Most of the manufacturers co-operated with the War Service Committee and with the government. This co-operation meant a saving of labor per unit of production, a saving of materials, including fuels, and a saving in transportation facilities.

Increasing costs and increasing federal taxation were doing much to reduce the margin of profit in the industry even before the manufacturers heard of the proposed restrictions. Skillful managers had already begun the burdensome task of trying to reduce the cost of production. The proposed restrictions, however, acted as a club to make the manufacturers begin to put into operation plans to save fuel, material and labor.

LARGE DROP IN FEBRUARY ELECTRICAL GOODS EXPORTS

For First Time in Many Months Figures Fall Below Four-Million-Dollar Mark—Eight Months Ended with February Show Total of $34,735,741

Official figures on the exports of electrical merchandise manufactured in the United States during February last give a total of $3,446,801, or more than $100,000 less than in February, 1917. This is the first time in many months that the export of electrical goods has fallen below the four-million-dollar mark. There is a very noticeable decrease in the exports of wire and cables. These had been falling off to some extent for a considerable period. Not all of this falling off has been in volume, however; some of it is accounted for by lower prices.

The figures for the eight months ended February last show a total of electrical exports of $34,735,741, as compared with $31,793,041 for the corresponding period of the previous year. The following figures were compiled by the Bureau of Foreign and Domestic Commerce:

Articles	February 1917	February 1918	Eight Months Ended February 1917	Eight Months Ended February 1918
Batteries	$227,105	$140,742	$1,769,158	$2,213,082
Carbons	.....	148,776	.....	979,036
Dynamos or generators	277,953	247,028	1,744,064	1,496,102
Fans	66,243	21,955	254,764	362,686
Heating and cooking apparatus	.....	49,614	.....	365,799
Insulated wire and cables	526,879	270,334	4,557,567	4,038,350
Interior wiring supplies, including fixtures	72,524	109,894	696,196	987,280
Arc lamps	842	387	7,793	7,702
Carbon-filament lamps	13,248	9,626	96,950	117,112
Metal-filament lamps.	153,475	228,866	1,048,174	1,882,873
Magnetos, spark plugs, etc.	.....	152,222	.....	2,290,168
Meters and measuring instruments	105,943	159,753	681,977	939,533
Motors	335,093	386,168	3,602,232	4,157,481
Rheostats and controllers	.....	8,520	.....	115,139
Switches and accessories	.....	210,643	.....	1,506,842
Telegraph apparatus, including wireless	18,324	24,601	191,712	198,703
Telephones	157,796	125,855	1,155,108	1,499,085
Transformers	84,105	125,240	740,446	1,304,468
All other	1,535,543	1,026,577	15,246,900	10,274,300
Total	$3,575,073	$3,446,801	$31,793,041	$34,735,741

METAL MARKET SITUATION

Propaganda for 25-Cent Copper — Weatherproof Wire Advance—Tin Exceedingly Scarce and High

A determined effort on the part of the producers and refiners is being made through propaganda to persuade the War Industries Board to advance the price of copper from 23.50 cents to 25 cents a pound. Reports are spread that this is now assured by those in "close touch with the producers." The increase, to follow the same authority, is to give the refiners 1¼ cents a pound and the producers ¼ cent. The production is also said to have decreased 14.7 per cent and the consumption of the metal to have swollen enormously. Yet one authority says: "It is very doubtful if this claim will be recognized by the government, as public statements issued by the various companies show that, compared with other metal industries, copper at 23.50 cents is the rich sister and spelter the Cinderella of the metal trade. There is no indication that recent production has not been equal to all demands." A week ago Holland placed an embargo on tin from the Dutch East Indies; indeed, one has practically been in effect since March. Weatherproof wire has advanced slightly in price.

No Straits tin is purchasable for any delivery or shipment. A nominal quotation of $1 was made this week. Chinese, May delivery, is quoted at 90.50 cents to 91 cents a pound. The Commercial Economy Board of the Committee of National Defense has been conferring with a large number of manufacturers, including producers of electric appliances, babbitt metal and solder. The purpose is to adopt means for the conservation of the tin supply, with a view of obviating an acute shortage of the metal. Old metals only show a shading in lead.

NEW YORK METAL MARKET PRICES

	April 22	April 29
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
	Cents per Pound	Cents per Pound
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	26.25 to 26.75	26.25 to 26.75
Lead, trust price	7.00	7.00
Nickel, ingot	50.00	40.00
Sheet zinc, f.o.b. smelter	Govt. price 15.00	Govt. price 15.00
Spelter, spot	6.83 to 6.87	6.85 to 6.90
Tin, Straits	92.00	92.00
Aluminum, 98 to 99 per cent.	Govt. price *32.10	Govt. price *32.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	21.50 to 22.00	21.50 to 22.00
Brass, heavy	13.50 to 13.75	13.50 to 13.75
Brass, light	10.50 to 11.00	10.50 to 11.00
Lead, heavy	5.75 to 6.00	5.75 to 6.00
Zinc, old scrap	5.50 to 5.62½	5.50 to 5.62½

*In 50-ton lots; car load, 32 cents per lb.

THE WEEK
IN TRADE

WITH a few changes in prices the sale of electrical goods in all parts of the country is maintaining a fairly high level. Commercial business, as against the tremendous buying of material and equipment for war uses, is rather quiet; but at that the volume and value are considerable. Floodlighting requirements for cantonments, camps and shipyards are large. There are also gratifying sales of domestic appliances, especially washing and sewing machines and vacuum cleaners. Rush shipments of conduit have relieved the situation in the Far West to some extent, but in the East stocks in several sizes continue scarce, owing, of course, to transportation delays.

Labor in manufacturing centers is becoming still more scarce, and the demand upon essential man power grows heavier. This is leading to a stronger demand for all kinds of labor-saving equipment and the more general employment of women.

Predictions that the great drive for the third Liberty loan would control collections do not seem to have been fulfilled. Credits are closely watched.

NEW YORK

District distributers and local jobbers are doing a very satisfactory business, civilian and governmental. Officials scour the market for electrical goods needed in manifold ways in the installation and upkeep of industrial enterprises engaged wholly or in part in the production of war material. The trade is lending every assistance in this respect cheeerfully and promptly, and with no little pride. The drawing on reserve stocks of staple merchandise, along stupendously liberal lines at times, is reducing the visible supply of many items, particularly conduit.

Some price advances have been made, and others are mentioned as likely to occur. As an example of how goods are moving it may be reported that shipments of electric apparatus from the plant of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., in March amounted to 1200 carloads, a new month's record.

Collections are referred to as running from fair to excellent, and credits firmly maintained.

HOUSEHOLD SPECIALTIES.—The stock of sewing machines is none too abundant, owing to the trouble and delays incident to obtaining fractional motors, the supply having shrunk in an unexpected way within the last month or longer. The production of vacuum cleaners of standard makes is also curtailed for lack of metal essentials—steel and aluminum. A shortage is probable, if not already present. Prices are stationary. Sales of electric washing and ironing machines are reported as heavy; in instances the demand exceeds the supply. This activity is stimulated by the scarcity of domestic help and the high wages insisted upon by laundry operatives. Two leading factories a few weeks since advanced prices 10 per cent on both ironing and washing machines. A Western-made washing machine was recently marked up 15 per cent. A local distributer announced these increases for the Eastern territory April 1. A shortage in both ironing and washing machines, owing to the difficulty of getting copper and galvanized iron, is impending. Delievries have lengthened on this account to about thirty days.

FUSES.—Renewable fuses are having a very good sale. Deliveries are what may be said to be prompt, no later than a week or ten days at the outside, owing largely to transportation delays. Where parcel post is utilized shipments are still shorter. Discounts to dealers in standard packages are quoted by one concern as 45 per cent; half package, 40 per cent; one-fifth package, 33 per cent. To

jobbers carrying the regulation stock the discounts are more liberal.

SOLDERING IRONS.—There was a run of short duration on local stock by jobbers. None of the orders was large. They came just prior to the schedule advance.

PORCELAIN.—Knobs, cleats and bushings are coming into the market very slowly, factories being swamped with orders and shipping restrictions creating no end of interference. The labor situation at the plants in Indiana, Ohio and West Virginia is occasioning grave concern.

POLE-LINE MATERIAL.—Yellow-pine cross-arms, oak brackets and locust pins are not available for small requirements. The government has requisitioned locust so heavily that the trade may have to consider substitutes. Rock elm is already employed in some localities.

CONDUIT.—Stocks are closely held, and conduit of all sizes is not being freely offered. Fittings for exposed work are in great demand, but jobbers are encountering difficulty in relying upon factory shipments, a condition which has prevailed for several months.

LAMPS.—Government and commercial requirements are being gradually caught up with by the producers, owing, it is said, to the enforcement of the daylight-saving law. The rumor of a higher price for lamps, which is being industriously circulated in some circles, is contrary to the language of the lamp contracts. Accordingly, no higher prices can be expected prior to 1919. No reserve stock has been accumulated at the factories.

ASBESTOS INSULATION.—Reported advances in asbestos mineral, which has been on the rise for a year and more, have not as yet affected the cost of asbestos insulation. Manufacturers state that no revision is contemplated, but with fluctuations in other lines "change without notice" may rule in this case.

CHICAGO

Seasonable goods of all kinds are selling freely, considering the various drawbacks by which the electrical trade is hampered. Dealers report better collections, which also are reflected in the statement of jobbers. The jobbing houses express a belief that there will be a serious shortage in motor fans, of the smaller sizes especially, and are advising retailers to place orders as soon as possible.

TELEPHONE BRACKETS.—There has been an extraordinary demand through jobbers for telephone brackets and extension arms. Most of this equipment is going to the government, probably to equip new offices which are being established. Two months' delivery is being quoted.

BOSTON

The volume of trade is still somewhat below that of a few weeks ago. The dearth of building operations is unquestionably a factor in the situation. It was announced a few days ago that the government plans to expend about $7,000,000 in increasing the repair facilities at the Boston Navy Yard. Collections are somewhat improved, despite the retrenchment to be seen in purely civilian business. Deliveries, on the whole, are better. Liberty loan financing occupies the center of the stage, and appliances are said to be moving a little slower in retail circles for this reason. Labor appears to be getting scarcer all the time. With the successive additions to the National Army the drain upon industrial man power grows heavier, and it will become more and more a factor in the sale of labor-saving equipment and the introduction of women into the commercial fabric.

ELECTRIC RANGES.—The demand for these exceeds the ability of central stations in the larger areas to provide the necessary service. Prices are steady. The principal limitation to a widespread extension of electric range application appears to be the restrictive policy of central stations regarding new services.

WASHING MACHINES.—Business continues remarkably healthy in these units. Even the smaller contractors and dealers are taking up the merchandising of washers successfully. No recent price changes are noted.

CONDUIT.—Nothing very encouraging can be said about deliveries. Some jobbers who stocked up long ahead of the present demand for larger-sized pipe are still filling orders promptly. With the government's restrictions upon conduit shipments the outlook is not very satisfactory for stock accumulation along broad lines.

APPLIANCES.—Business is a little quieter, owing, according to some observers, to popular absorption in the third Liberty loan campaign. Vacuum cleaners are moving well, as are irons, toasters and heating pads.

MOTOR-DRIVEN COAL LOADERS.—The demand is very healthy for portable machines of this type. One New England manufacturer is placing at least one outfit a week in service by making delivery over the road and ordering stock from Boston distributers. The small alternating-current motors used are now being obtained with little delay through city jobbers.

FLASHLAMPS.—Dealers report a shortage in miniature lamps and some difficulty in filling stocks due to railroad delays. Government demands are very heavy for miniature lamps and have interfered with the production of standard types. Sales to cantonments and navy yards are in good volume, the former paralleling the various draft movements campward.

FARM LIGHTING SETS.—Inquiries are coming in faster as the road conditions improve in the interior, and the outlook is excellent for the summer's business. An advance in the price of storage cells was scheduled for May 1, but the increase on farm lighting sets recorded some weeks ago appears to absorb this without present need of further rise.

FUSES.—Stocks are substantial and business is well maintained.

ASBESTOS AND EBONY BOARD.—The demand for this material is very heavy for both land and marine work. Labor is scarce, and prices were advanced about two weeks ago. Factory facilities are hard pushed to get out the orders now on the books, and there is a present scarcity in the more common thicknesses of this insulating material.

PORCELAIN FITTINGS.—Some improvement in deliveries is noted. The available stocks are rather spotty in regularity of sizes and types, but the situation is showing signs of real betterment.

ATLANTA

Although indications point to a lessening of activity in industrial ventures and construction for this week, the volume of building appears to be holding up fairly well, considering the fact that all energies are now being utilized to put across the third Liberty loan. New organizations are confined principally to cotton products, oil refineries and minerals. Government expenditures in the South continue as anticipated. Extensive construction is being carried on in Alabama, Florida, Georgia, North Carolina and bordering States. This construction covers barracks, hospitals, warehouses, aviation field developments and cantonment extensions. Manufacturers report a falling off in inquiries and actual sales to central stations. The volume of sales in large apparatus has reached a low level.

TRANSFORMERS.—The call for distributing-type transformers from the central stations shows a decrease, with a corresponding report from factories that capacities up to 100 kva., 2300 volts to 6600 volts, are promised for four weeks, 33,000 volts for six weeks. Ratings up to 200 kva. covering the same voltage range are promised for eight weeks. The slowing up of central-station demand is offset to some extent, however, by steady government buying of ratings from 50 kva. to 200 kva. Local stocks are in good shape in capacities to 25 kva. While freight embargoes are affecting all lines more or less, transil oil, especially, is slow in coming in. Rumors are afloat that transformers are due for a jump in price soon.

SERIES LIGHTING OUTFITS.—Manufacturers report that business from the central stations is light. A strong demand continues, however, from government sources. A substantial demand exists, too, from textile mills for village

street lighting. This class of business has created a strong demand for the pole-type constant-current transformer. Stocks of the stationary-coil type are good. Shipments on the movable-coil type are promised for four to six weeks.

FLOODLIGHTING.—The volume of sales to industrials and government account is big, with a decided increase over the past few months. For spot-light purposes the 400-watt is popular, but for general floodlighting the 1000-watt unit seems to come in for greater utility. Shipments are slowing up materially, owing to the fact that factories are deluged with orders. Local stocks are kept depleted by constant government requirements necessitating immediate delivery. Prices remain steady.

INSTRUMENTS.—Substantial sales are recorded for the various switchboard types. The volume of sales originates at industrial sources, however, as very little business of this nature is coming from central stations at this time. The demand for portables is steady and satisfactory. Shipments are very good considering present conditions.

METERS.—A decided slump has been noted of late, covering both the popular residence and the polyphase power type. The present volume of business compared with last year shows a decrease of approximately 50 per cent.

OIL CIRCUIT BREAKERS.—A steady demand exists from industrial sources. Central-station sales are off, showing only spotty tendencies of improvement. Shipments continue slow.

SEATTLE

A gratifying volume of sales for the past month is being maintained along the line of domestic appliances. There has been a noticeable increase, particularly in sales of washing machines and vacuum cleaners of the small hand type. Sales of sewing machines also show a decided increase over the past week. Retailers report the movement of sewing and washing machines as unexcelled. The feature of the week's business, however, was the award of a contract for a large amount of general electrical supplies for shipyards in the Portland territory. The larger part of the order was schedule materials, although there was some power apparatus. With but one exception this contract was the largest awarded since the first of the year. There were no fluctuations in prices during the week, although some were expected.

The arrival of several cars of conduit assisted materially in relieving the strained condition which has existed the past month. Notices were received by local jobbers of other cars en route, and the situation at present looks considerably brighter. A carload shipment of sewing machines will fill back orders and replete exhausted stocks. The lamp shortage in Seattle is relieved somewhat, still there is a dearth of larger sizes. Sales to shipyards and industrials in the Seattle field show no decided increase or decrease. The Gray's Harbor and Portland fields report increasingly heavy sales. The establishment of several projected concrete shipbuilding plants in the Northwest at Everett, Tacoma and Vancouver, Wash., is attracting considerable attention.

Authorities state that the actual production of lumber under the eight-hour day in the Pacific Northwest continues to be approximately 10 per cent less than under the normal ten-hour capacity. Indications point to heavily increased government buying to care for additional cantonment building, ship materials and for 100,000 freight cars. It is unofficially reported that car building at plants in Seattle, Tacoma and Portland will share in the government's car-building program.

Reports from various cities in the Northwest indicate that building operations this summer will be much greater than in many years. In line with other shipbuilding cities in the Northwest Astoria, Ore., has taken steps to secure a portion of the fifty-million-dollar fund appropriated by Congress for the relief of the shipyard housing problem. Spokane is experiencing unusual activity in building with particular reference to repairs and improvements of medium-priced residence properties. Smaller towns throughout the Inland Empire also report increased building.

Within the next few weeks an army of 3000 soldier farmers will be released from military duties at Camp Lewis to assist farmers in eastern Washington and Oregon in planting spring crops.

Pole-line materials, replacements and general maintenance work, especially in eastern Washington, have resulted in increased sales of poles, cross-arms, insulators, etc. The volume of sales in the Puget Sound territory is below expectations. Along this line utility companies are confining themselves strictly to maintenance work. In porcelain the predicted advance has not materialized. Recent heavy sales have reduced stock materially. New stocks are comparatively hard to obtain. Collections are not suffering from the Liberty loan drive.

SAN FRANCISCO

The electrical business is slowing up, especially in the volume furnished by dealers and contractors.

Collections are reported slower than for a few weeks past. The most notable building permits are still for canneries, Rosenberg Brothers reporting a five-hundred-thousand-dollar packing and storage plant. And it is significant that similar work in Mountain View has been held up for lack of industrial housing. Representations have already been made to Washington in this regard. The United States government has leased forty additional acres for its San Pedro cantonment and intends to enlarge the Letterman Hospital in San Francisco and the Benicia Arsenal. Notable shipbuilding construction is a four-way equipment for the Union Construction Company at the Oakland mole and a larger plant and concrete dry dock for the Rolph Shipbuilding Company on the Alameda shore of the bay.

BELLS.—Sales of small iron box bells are slow, but there is a big call for large bells, especially waterproof bells and specially wound types for shipbuilding work. This demand is so large and so well maintained that some manufacturers are carrying large-sized bells of this sort wound for 100-volt direct current for Pacific Coast delivery. Also to be noted is the increasing use of transformer bells.

HOUSE GOODS.—This line, which includes annunciators, push-buttons and other fancy electrical hardware, is very slow, owing to lack of house and hotel wiring.

SCHEDULE MATERIAL.—Demand has suffered in common with all other staple contracting lines. Because of increase in freight rate the prices on standard sockets and switches are to be advanced 10 per cent. The best-moving schedule item just now is the National Code fuse, which is being supplied in lots of 1000 and 5000 to shipbuilding plants.

FIRE-ALARM MATERIAL.—Each week brings its quota of inquiries, most of which originate from lumber plants and mines, although the increasing lawless element has caused several towns to consider some assistance. Particularly noticeable is the demand for electric sirens, which seem to have been standardized for effective alarm work.

CONSTRUCTION TOOLS.—The demand is very slack on account of a lack of extension work and because of the quiet winter, which was free from storms that necessitated reconstruction.

TAPE.—The total demand is about 20 per cent below that of last year, but tape is difficult to get from the Eastern factories, which usually require four weeks to fill an order. To this must be added forty days for delivery to the Pacific Coast.

STANDARD PORCELAIN MATERIAL.—The demand is very quiet because of lack of country house-wiring jobs. Stocks are good.

GLASS INSULATORS.—The price was recently advanced about 15 per cent because of the increased freight rate. There is very little demand owing to the almost complete shut-down on all power extensions. Local stocks are good, in fact, too good for present conditions.

RAILWAY EQUIPMENT.—Stocks are big, with absolutely no demand, save for a few extra field coils. Practically no railway motors are being shipped.

LAMPS.—Deliveries and sales are good, and, as the market is in a very healthy condition, the sales from lamp agents are good and are well handled.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List to $61.00
Coil to 1000 ft	10% to 57.25
	No. 12 Solid
Less than coil	List to $71.00
Coil to 1000 ft	10% to 66.75

Twin-Conductor

	No. 14 Solid
Less than coil	List to $104.00
Coil to 1000 ft	$97.75 to 10%
	No. 12 Solid
Less than coil	List to $135
Coil to 1000 ft	10% to $126.80

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%
	No. 12 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%

Twin-Conductor

	No. 14 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%
	No. 12 Solid
Less than coil	15% to + 10%
Coil to 1000 ft	10% to 20%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10% to $24.00
1/5 to std. pkg	20% to 19.80
Std. pkg.	34% to 18.75

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+ 20% to 12%
1/5 to std. pkg	20% to List
Std. pkg.	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28 to .285	.29 to .295

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175-.3195	.3275-.3295
Barrel lots	.2875-.2895	.2975-.2995

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 100 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
3/8-in. s. stp.	Net to $75.00	—15% to $69.75
3/8-in. d. stp.	+10% to 75.00	List to 72.00
1/2-in. s. stp.	List to 100.00	—15% to 93.00
1/2-in. d. stp.	+10% to 100.00	List to 96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.75
3/8-in. double strip	78.25-78.75	71.25-71.75
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00-$55.00	$20.50-$24.45	$20.00-$21.50
1/4-in.—	$28.00-$60.00	$22.50-$27.00	$22.00-$23.50

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$36.00-$55.00	$25.00	$22.50
1/4-in.—	$40.00-$60.00	$27.00 to $29.00	$25.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	4% to 12%	7% to 15%
2500 to 5000 lb.	6% to 14%	9% to 17%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	5.3% to 8.9%	8.3% to 11.9%
2500-5000 lb.	7.3% to 10.9%	10.3% to 12.3%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.00
Discount	30%

CHICAGO

List price	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	28% to 30%
1/5 to std. pkg.	38% to 40%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00
1/5 to std. pkg.	4.50

Standard packages, 500. List, each $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard packages, 500. List, each $0.07.

LAMPS, MAZDA

105 to 125 Volts

	Std. Pkg.	List, Each
Regular, clear:		
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3½-in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾-in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4⅝-in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg. ..... Net
Std. pkg. 10%

DISCOUNT—CHICAGO

Less than std. pkg. ..... Net
Std. pkg. 10%

LAMP CORD

Cotton Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00 to $34.90
Coil to 1000 ft.	26.20 to 27.90

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$29.00 to $30.00
Coil to 1000 ft.	21.50 to 22.30

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100 ..... $24.00

CHICAGO

Net per 100 ..... $21.75 to $25.75

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½ 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%	20%
$10.00 to $50.00 list	42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. 10%
1/5 to std. pkg. 20%
Std. pkg. 30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg. 10%
1/5 to std. pkg. 20%
Std. pkg. 30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to 20.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
	5½ N.C.—Solid	Nail-it—N.C.
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
	5½ N.C.—Solid	Nail-it—N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10 to $11.40	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. ..... Net to $25.00
1/5 to std. pkg. ..... 15% to 20%

NET PER 100—CHICAGO

Less than 1/5 std. pkg. ..... 24% to 25.00
1/5 std. pkg. ..... 30% to 23.00

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100 amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low-Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+ 5%
$10 to $25 list	11%
$25 to $50 list	14%
	Low-Grade
Less than $10 list	5%
$10 to $25 list	16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Cont'd

DISCOUNT—NEW YORK

Less than 1/5 std. pkg. ..... List
1/5 to std. pkg. 15%
Std. pkg. 28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg. ..... + 20% to list
1/5 to std. pkg. ..... List to 15%
Std. pkg. 30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List, Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List to 40%	Net to 30%
$2.00 to $10.00 list	10% to 50%	5% to 40%
$10.00 to $50.00 list	20% to 64%	15% to 52%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25%	20%

TOASTERS, UPRIGHT

NEW YORK

List price $6.00
Discount 30%

CHICAGO

List price ..... $4.50 to $6.00
Discount ..... 25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41¼-$0.44¼
No. 18, full spools	0.36¼- 0.43¼

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.57½ to $0.65
No. 18, full spools	0.50½ to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00-$18.00	$12.50-$13.00	$9.85-$11.50
12	23.25- 25.40	21.30- 21.80	15.95- 19.35
10	32.40- 35.20	29.70- 30.20	22.10- 27.00
8	45.70- 49.15	41.90- 42.10	30.85- 38.00
6	72.40- 77.85	66.35- 66.75	48.95- 60.30

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00	$13.00	$11.50
12	25.33-$26.25	22.02-$25.33	18.35-$20.93
10	30.49- 36.54	27.94- 31.26	22.86- 29.23
8	42.54- 51.57	38.99- 44.13	31.90- 41.36
6	66.46- 88.38	56.15- 75.61	50.53- 70.70

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$33.25 to $35.40
25 to 50 lb.	34.40
50 to 100 lb.	30.40 to 34.14

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$35.42 to $40.00
25 to 50 lb.	34.42 to 39.35
50 to 100 lb.	33.42 to 38.25

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Heavy-Duty Polarized Attachment Plugs

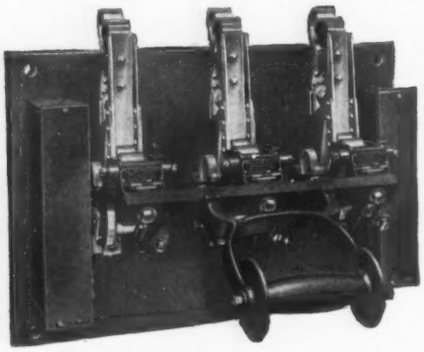
An attachment plug designed to be used interchangeably with heavy-duty polarized wall and flush receptacles has been recently placed upon the market by Harvey Hubbell, Inc., Bridgeport,

KNIFE-BLADE CONTACTS PLACED AT RIGHT ANGLES

Conn. This heavy-duty polarized attachment plug is rated at 660 watts and 250 volts. The knife-blade contacts are placed at right angles to each other to assure polarization.

Circuit Breaker with Self-Timing Attachment

A self-timing circuit breaker for the protection of motors during starting or running is being manufactured by the Roller-Smith Company, 233 Broadway, New York City. Interposed in the path of the trip armature is a pivoted hook-shaped barrier under two independent controls. One control is thermal and depends upon the expansion of an iron rod. This rod is heated at the same rate as the motor, which is being protected by the same current that operates the motor. When the rod expands it retracts the barrier, causing the breaker armature to trip when the



BARRIER CONTROLLED BY TWO INDEPENDENT METHODS

heating is excessive. It does not matter how this excess comes about—it may be either a prolonged starting current in the motor or a variable load with high requirements.

The other control, which is electromagnetic, retracts the barrier instantaneously if a mechanically dangerous load is suddenly applied.

Both controls are adjustable for either the maximum current which may continuously flow or the emergency overload value. They may be adjusted independently if desirable. Ordinarily, however, the controls are set to protect the average motor of normal ampere rating, therefore no further adjustment is required.

Combined Washer and Wringer

A combined washer and wringer in which a dolly and a disk are used to agitate the clothes is being manufac-

REVERSIBLE WRINGER MAY BE PLACED IN FOUR DIFFERENT POSITIONS

tured by the Superior Machine Company, Sterling, Ill. It is known as the "Submarine" type and is belt-driven by a 0.25-hp. electric motor, which also operates the wringer by means of gears and rod drive. The wringer is reversible and may be placed in four different positions, so that all of the operations, involving rinsing, wringing, etc., can be performed easily. This line of washing machines is manufactured in several different styles including a short-bench type, a twin-tub washer with wringer in between, and an extended-stave-leg type.

Attachment Plug with Few Parts

An attachment plug that has no screws to disassemble or lose is being manufactured by Mueller Electric Company, 423 High Avenue, Cleveland, Ohio. The plug has screw connections, so soldering is not required for connection to the appliance. An interesting method is used to connect the terminal to the brass shell of the plug. The brass shell, as shown in the accompanying illustration, is removed, and the terminal is inserted through the slot in the composition shank. The

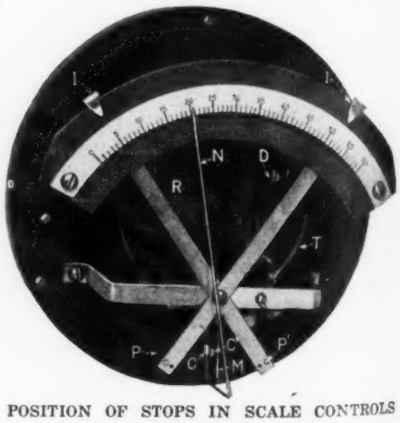
TERMINAL CONNECTION MADE BETWEEN SHELL AND COMPOSITION SHANK

brass shell is then replaced and when screwed on to the composition shank holds the terminal against the shank in such a manner as to provide a permanent connection. The device is small and adapted for any kind of electric appliance.

Automatic Pressure Governor

A pressure governor to control standard self-starters for motor-operated pumps and compressors has been developed by the General Electric Company, Schenectady, N. Y. The governor will maintain a pressure betwen predetermined limits on any gas or liquid systems that will not corrode the Bourdon tube.

This governor is listed as CR 2922 and can be used on any standard alter-



POSITION OF STOPS IN SCALE CONTROLS RANGE OF PRESSURE IN TANK

nating-current or direct-current circuit. It is rated for pressures of from 60 lb. to 500 lb. (89 kg. to 69 kg. per sq. cm.) and will operate within settings of from 3 lb. to 12 lb. (1.4 kg. to 5.4 kg.) between high and low pressures. Gov-

ernors for higher pressures can be supplied if desired.

The governor consists of a Bourdon tube, an indicating needle, a graduated pressure scale, adjustable pressure stops and a relay which actuates the contacts in the control circuit of the self-starter. The free end of the tube *T* in the illustration produced herewith is mechanically connected to the indicator needle *N* and moves it over the scale as changes of pressure affect the tube.

When the pressure is at the low limit the contact *C* on the needle *N* completes the circuit through the contact *C'* on the movable arm *M*, which at the low-pressure limit rests against the stop *P*. When this contact is made the circuit is completed through the relay coil *R*, causing the armature to close, and causes the motor to operate. The relay armature is attached to the spring which holds the contact *C* firmly against *C'* until contact is broken at *P*.

As the pressure increases the needle pointer moves to the right, and its lower part, to which the contact *C* is attached, moves to the left, followed by the movable arm *M*. When the high-pressure limit is reached the movable arm is prevented from traveling further by stop *P*. The needle continues its course, breaking the circuit by separating contacts and de-energizing the relay *R*.

Automatically Controlled Electric Pump

Mast, Foos & Company, Springfield, Ohio, have recently placed on the market the "Buckeye" electric house pump for use with cisterns and shallow wells. It can be operated by energy from electric service or trolley lines or from a farm lighting and power system.

The pump is controlled by an automatic switch and is provided with large oil pockets for all bearings. It therefore requires very little attention. The

AIR CHAMBER INSURES STEADY FLOW OF WATER

driving mechanism is totally inclosed and runs in grease. Felt washers prevent the grease escaping or dirt getting into the bearings. Roller bearings of a special type are used that insure easy starting, a minimum amount of power for operation, perfect alignment, and durability.

The outfit is rated at 180 gal. (681.3 l.) per hour, which is said to be sufficient for supplying all the water that would be required for the bathroom, kitchen and laundry of an ordinary dwelling. It is equipped with an air chamber and vacuum chamber to prevent water hammer and to insure a steady flow of water. The valves are faced with rubber to eliminate any noise in operation.

Very small floor space is required for this outfit because the pump is of the vertical type of construction and the motor and driving mechanism are placed directly above the pump proper.

A Motor-Operated Rubbing Machine

A motor-operated rubbing machine for wood-surface finishing has been developed by the Mattison Machine Works of Beloit, Wis. The machine is operated by a General Electric Company fractional-horsepower motor which moves the rubbing blocks together and

DUST-PROOF CASE PREVENTS INJURY TO THE MOVING PARTS

apart at an even speed. The speed is governed by a regulator which can be varied according to the class of work to be done. The machine is inclosed in a dust-proof aluminum case and weighs about 35 lb. (15.8 kg.). This weight gives sufficient pressure for ordinary purposes, but additional pressures can be applied by the operator if it is desired. The device can be used for rubbing surfaces 15 in. (3.8 cm.) in length and of practically any width. It may be attached to an ordinary light socket and consumes about 250 kw.-hr. of energy.

Hand and Face Drying Machine

A machine that will heat and blow air through an adjustable nozzle for drying the face and hands has been placed upon the market by the Groton Electrical Devices Company of New York City. The machine consists of a white-enameled iron standard with a motor, fan, heating element and mirror. It may be connected to ordinary lighting circuits. The machine is set in operation by means of a foot lever at the base of the standard. The nozzle through which the air is discharged is adjustable so that the air may be directed on the hands or up into the face. This device is particularly adaptable to general washrooms in hotels, office buildings and public places.

Disk Stove Chafer

A device that can be used as a chafer disk stove, a frying pan or a saucepan has been developed by Landers, Frary

ELECTRIC STOVE OF MANY USES

& Clark of New Britain, Conn. The two-heat appliance is equipped with a clamp which holds the pans in place on the stove. Either pan may be placed upon the stove separately or the stove may be utilized as an ordinary disk stove.

Loom Fastener for Outlet Box

A loom fastener, approved by the National Board of Fire Underwriters, that will fasten two pieces of loom at one time to an outlet box is being manufactured by J. J. Duck, 432 St. Clair Street, Cleveland, Ohio. The fastener will grip a piece of loom extending only 0.25 in. (0.63 cm.) through a box or plate. When a stud is used on the outlet box the same bolt or screws that hold the stud will also serve to hold the fastener in place. The device is made of spring brass and will hold 0.21 in. (0.56 cm.) and 0.25 in. (0.63 cm.) flexible tubing.

Open-Construction Pipe Bender

An open-construction pipe bender that will bend conduit or pipe at any angle from 1 deg. to 180 deg. is being manufactured by the Akron Electric Company of Akron, Ohio. The bender is light in weight and is strongly con-

PIPE MAY BE INSERTED AND REMOVED WITH EASE

structed. It consists principally of a small bending wheel and a roller. Only a very small amount of energy is required to bend the pipe. It is constructed so that the pipe may be inserted and removed easily.

Trade Notes

G. A. BINZ, formerly manager of the meter department of the Yarnall-Waring Company, Philadelphia, has been appointed sales manager.

N. M. GARLAND of New York City, district manager of the Ohio Brass Company, Mansfield, Ohio, has been elected a member of the board of directors.

THE PARAGON ELECTRIC COMPANY of Chicago on May 1 removed from 9 South Clinton Street to larger quarters in the Old Colony Building, 37 Van Buren Street.

THE JEFFERY-DEWITT COMPANY, manufacturer of high-tension disk insulators, will after June 1 move its factory from Detroit, Mich., to Kenova, W. Va.

LANDERS, FRARY & CLARK of New Britain, Conn., have purchased the business of the National Electric Utilities Company, of New York City, and will increase and develop it.

THE SUNDH ELECTRIC COMPANY of New York City on May 1 removed its main offices and factory to Avenue C and Parkhurst Street, Newark, N. J. The New York office is at 51 East Forty-second Street, room 301.

ALBERT TATE SMITH, lately manager of the R. U. V. Company, 50 Broad Street, New York City, has returned to the Permutit Company, with which he was formerly connected, to take the position of assistant manager of sales. Mr. Smith is widely known in the water purification field.

THE MACLEOD MANUFACTURING COMPANY of Chicago announces that it will move from its present factory at 420 Orleans Street to its new building at the corner of Austin and Wells Street. This company manufactures extension brackets for telephones and other office supplies.

THE SPRAGUE ELECTRIC WORKS OF THE GENERAL ELECTRIC COMPANY, New York City, announces the removal of its office in Boston from 201 Devonshire Street to 84 State Street, room 906; also the removal of its quarters in St. Louis from the Chemical Building to the Pierce Building, room 1352.

CHARLES C. SCHNEIDER, manufacturers' agent, has moved from 329 to 327 Broadway, Market Building, Detroit, Mich., where larger quarters have been secured. Mr. Schneider, who represents the Pittsburgh Lamp, Brass & Glass Company, has recently added to his line the transformers made by the Cumberland Electric Company of Memphis, Tenn.

THE NATIONAL BANK OF COMMERCE of New York City has printed the export trade associations act (Webb act), as approved April 11, with annotations, in convenient pamphlet form. The enactment of the law is a decisive step in the direction of an expansion of foreign trade. Copies may be had by applying to the foreign department of the bank.

FRED W. GODFREY has severed his connection with the Republic Electric Company to become associated with the American Carbon & Battery Works of the National Carbon Company, Inc., of East St. Louis, Ill. Mr. Godfrey will cover all of Minnesota, North and South Dakota, Nebraska, Colorado, Montana, Wyoming, Utah, Idaho and New Mexico. He has traveled the Central West for many years.

W. W. EWING, special agent of the Department of Commerce, Bureau of Foreign and Domestic Commerce, of Washington, D. C., has just finished an investigation, made on the ground, of Colombian markets for construction materials and machinery. In this report will be found a general introduction covering industries, resources, means of communication, architecture and construction, etc., in Colombia, S. A., and chapters devoted to specific building activities, markets for particular lines of materials and machinery, and commercial practices and requirements—all the preliminary data needed to form an estimate of the possibilities of the field. Mr. Ewing finds that Americans have a bigger business in Colombia now than when the war started and sees no insurmountable obstacles in the way of doing even better when peace is made. Copies of the report can be obtained by writing to the superintendent of documents, Washington, D. C., or to any of the district offices of the Bureau of Foreign and Domestic Commerce. The co-operative offices have copies for those who apply in person.

GERMAN-RUSSIAN TARIFF DISPUTES.—The strained tariff relations that existed between Russia and Germany much of the time between 1890 and the outbreak of the war are described in a report just made public by the Bureau of Foreign and Domestic Commerce, Department of Commerce. The author of the report, Louis Domeratzky, tariff expert of the bureau, gives it as his opinion that, aside from political contingencies, which were not without influence on the tariff relations of the two countries, Russia has been at a disadvantage in negotiating commercial treaties with Germany. The author considers it extremely hazardous to make any forecast as to the future tariff relations between the two countries, but discusses at some length the situation as it existed a few months before the war started. Copies of "Tariff Relations Between Germany and Russia," Tariff Series No. 38, can be obtained at the nominal price of 5 cents from the superintendent of documents, Government Printing Office, Washington, D. C., or from any of the district or co-operative offices of the Bureau of Foreign and Domestic Commerce.

Trade Publications

COAL CONVEYOR.—A single-rope coal conveyor is described and illustrated in a circular distributed by John F. Godfrey of Elkhart, Ind.

VACUUM CLEANERS.—The "Liberty" cleaner, Model C, is described in a folder issued by the Innovation Electric Company, Inc., 585 Hudson Street, New York City.

PLANERS.—The Powell Machine Company, Worcester, Mass., is distributing descriptive bulletins of its various patent planers for high-speed cuts and for standard work.

BUSBAR SUPPORTS.—The Electrical Engineers' Equipment Company is distributing advance sheets on its bulletin No. 107, which describes its new line of busbar supports.

ELECTRIC APPLIANCES.—A catalog and price list of electrical appliances is being distributed by the Hotpoint division of the Edison Electric Appliance Company, Inc., of Ontario, Cal.

SECTIONAL CABINETS.—Sectional cabinets for display counters and for holding tools are illustrated in a bulletin recently issued by Stevens & Company, 375 Broadway, New York City.

CLAMP INSULATOR SUPPORTS.—The General Devices & Fittings Company, Mid-City Bank Building, Chicago, has recently issued a bulletin describing its new clamp supports for pipe and flat mounting.

BLUEPRINT RACKS—The "Presto" quick-acting holder for blueprints, records, charts, drawings, newspapers, etc., is illustrated in a circular distributed by the National Company, 275 Congress Street, Boston.

REGULATORS AND ADAPTERS.—Regulators and adapters for motion-picture projection for Mazda lamps are covered in a bulletin recently issued by the Argus Lamp & Appliance Company, 322 Euclid Avenue, Cleveland, Ohio.

MOTOR-GENERATOR SETS.—Bulletin No. 3602 is being distributed by the Emerson Electric Manufacturing Company of St. Louis, describing its alternating-current motor-generator sets both with and without switchboards and rheostats.

CIRCUIT BREAKERS.—The Roller-Smith Company of 233 Broadway, New York City, is distributing bulletin No. 501, describing its "self-timing" circuit breakers. These circuit breakers are both thermally and electromagnetically controlled.

SWITCHES.—The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., has recently issued a small two-color envelope folder, publication No. 242, which illustrates and describes the single and two-circuit brass shell used in its porcelain pendent switches.

OXY-HYDROGEN GENERATOR.—The Electrolytic Oxy-Hydrogen Laboratories, Inc., 15 William Street, New York City, have issued a bulletin describing the Levin oxygen and hydrogen generator. The products of this company are sold under the trade name of "Electrolabs."

CENTRIFUGAL PUMPS.—The Wheeler Condenser & Engineering Company of Carteret, N. J., has recently published a bulletin, No. 108-B, embracing its line of centrifugal pumps. The bulletin shows the latest Wheeler turbine-driven geared centrifugal pumps of various types. Pumps are made for nearly all requirements where large volumes of water must be pumped against low heads.

INCLOSED SWITCHES.—The Square D Company, Detroit, Mich., has issued a new catalog, No. 24-B, describing the Square D steel inclosed safety switches. The book is of convenient size and can be carried in the pocket for ready-reference purposes. Prices and descriptions of the entire Square D line are given, together with a table of wiring data for single-phase, three-phase and direct-current motors.

LIGHTING APPARATUS.—"Stage and Studio Lighting Apparatus and Electrical Effects" is the title of a new catalog issued by the Universal Electric Stage Lighting Company, 240 West Fiftieth Street, New York City. The bulletin illustrates and describes many developments in stage lighting which have recently been accomplished. Accessories for motion-picture photography are also included in the bulletin.

STOKERS.—The Sanford Riley Stoker Company, Ltd., Worcester, Mass., has issued a new catalog describing the Riley underfeed stoker. The booklet is well illustrated and shows the construction features and installations of the stokers. Engineering data are also given, together with outline drawings showing the cross-sections and views of different boiler installations. A separate circular included in the catalog gives a list of representative installations of Riley underfeed stokers.

COPPER CASTINGS.—The Titanium Bronze Company, Inc., Niagara Falls, N. Y., has issued a bulletin entitled "High-Conductivity Copper Castings." The bulletin describes copper castings, their manufacture and method of rolling, and tells why high conductivity is needed. Small quantities of impurities present in copper castings may reduce their conductivity by even one-half. Tables are given showing the effect of a mixture of copper with specific quantities of various substances.

ELECTRICAL DEVICES.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued several additions to its catalog, describing overhead relays, automatic starters and portable hoists and dumbwaiter motors. The company has also published electrification data in a bulletin entitled "Electrification of Railroads as a War Measure." This bulletin gives the mechanical features of electrification and shows the various characteristics of electric locomotives used in the electrification of steam railroads.

New Incorporations

THE BRANTLEY ELECTRICAL COMPANY of Terrell, Tex., has been chartered with a capital stock of $2,000 by A. L. Brantley and others.

THE HELD ELECTRIC COMPANY of Utica, N. Y., has been incorporated by J. E. Vaeth, H. I. and J. P. Held of Utica. The company is capitalized at $5,000 and proposes to manufacture electrical goods.

THE STERLING ELECTRIC COMPANY of Sacramento, Cal., has been incorporated with a capital stock of $25,000 by W. A. Weight, C. Weight, C. E. Turner, T. L. Nightingale and Lee Gebhart, Sacramento.

THE ACME-ELECTRIC OIL COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $250,000. The incorporators are: Charles D. Allee, J. B. Bailey and L. B. Phillip of Dover, Del.

THE IDEAL ELECTRIC THERAPEUTIC APPARATUS CORPORATION of New York, N. Y., has been incorporated with a capital stock of $5,000 by A. and S. Cooper and D. Hertman, 160 East Twenty-third Street, New York City.

THE SLUGLAND POWER COMPANY OF NEW JERSEY has filed articles of incorporation with a capital stock of $250,000. The incorporators are: Leonard Slugland, Frank P. Venable, John H. Mussiner, Louis J. Patmos, all of Paterson, N. J.

THE W. & R. MANUFACTURING COMPANY of New York, N. Y., has been incorporated with a capital stock of $100,000 by A. J. Lalibert, L. T. Fetzer and H. Macintyre, 220 West Forty-ninth Street, to make heating and lighting systems.

THE PROGRESSIVE ELECTRIC COMPANY of New York, N. Y., has been chartered by George F. Broyn, 1462 Vyse Avenue, Bronx; Joseph Segal and Philip Segal of New York, N. Y. The company is capitalized at $5,000 and proposes to manufacture and deal in electric equipment.

THE TIRRILL MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $50,000 and proposes to manufacture electric-light controllers. The incorporators are: C. L. Rimlinger, M. M. Clancy and F. A. Armstrong of Wilmington, Del.

New England States

PLYMOUTH, N. H.—The Plymouth Electric Light Company is erecting an electric transmission line to the village of Livermore Falls, a distance of 2 miles, to supply electrical service there. Electricity will also be supplied to residents along the line.

PORTSMOUTH, N. H.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 6, under specifications 2904, for furnishing and installing an intake tunnel and circulating pump at the navy yard at Portsmouth, N. H. The cost is estimated at $45,000.

BOSTON, MASS.—Bids will be received by the lighthouse inspector, Boston, Mass., until May 7 for two oil-engine-driven air-compressing outfits. Further information may be obtained at the above office.

PALMER, MASS.—Plans are being prepared by the Wright Wire Company, 69 Hammond Street, Worcester, for the erection of a new power house, 100 ft. by 125 ft., at its local plant. Griggs & Myers, 110 West Fortieth Street, New York, N. Y., are architects and engineers.

BRIDGEPORT, CONN.—Contract has been awarded by the Bryant Electric Company to Martin & Son for the construction of an addition 60 ft. by 128 ft. to its plant.

Middle Atlantic States

BUFFALO, N. Y.—Plans are being prepared by Frank M. Williams, state engineer, Albany, for a freight and transfer warehouse for the New York State Barge Canal Terminal, Erie Basin, Buffalo, which will be equipped with crane and conveying equipment.

BUFFALO, N. Y.—The final schedule of streets is now being arranged in connection with the installation of the proposed new underground conduits to replace the present overhead wires in various districts of the city. The work will be done by the New York Telephone Company, the Buffalo General Electric Company and other public utilities operating in this section.

MASSAPEQUA, N. Y. — Contract has been awarded by the Board of Supervisors of Nassau County to the Tucker Electric Construction Company, 114 West Thirtieth Street, New York City, for the electrical work in connection with the erection of the new tuberculosis hospital at Massapequa.

MOHAWK, N. Y.—Plans are being prepared by Frank M. Williams, state engineer, Albany, for the construction of a hydraulic power plant on the State Barge Canal at Mohawk, N. Y.

NEW YORK, N. Y.—Contract has been awarded by the board of trustees of Bellevue and Allied Hospitals, 415 East Twenty-sixth Street, to Charles K. Daly, 172 Paynter Street, Long Island City, for the construction of a power house.

NIAGARA FALLS, N. Y.—Plans for power development by the merged Niagara Falls Power Company, the Cliff Electrical Company and the Hydraulic Power Company, authorized by the State Legislature, have been approved by the War Department. Construction work, involving an expenditure of about $16,000,000, to permit the development of 400,000 hp. from 20,000 cu. ft. authorized to be diverted from the Niagara River by the British-American treaty, will begin as soon as the federal government sanctions the consolidation.

SYRACUSE, N. Y.—Plans are being prepared by the Syracuse Lighting Company for the construction of an electric plant on South Warren Street.

SYRACUSE, N. Y.—The Continental Can Company of Syracuse has awarded contract for the construction of a power house and coal pocket at its factory, to cost about $60,000.

WATERVILLE, N. Y.—Plans are under consideration by the Waterville Gas & Electric Company for the construction of a new electric plant.

BLOOMFIELD, N. J.—Plans are being considered by the Town Council for improvements to the electric fire-alarm system.

BORDENTOWN, N. J.—Plans are being considered by the City Commissioners for the installation of electrically-operated pumps at the waterworks pumping station.

CAMDEN, N. J.—Permit has been taken out by Kind & Lantesmann for the construction of a new boiler plant at the head of Fifth Street.

HAMBURG, N. J.—The township committee is considering the installation of a new electric street-lighting system.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

JERSEY CITY, N. J.—Plans are being considered by Swift & Company, 154 Ninth Street, for building an addition to their engine and power plant on Henderson Street, to cost about $23,700.

NEWARK, N. J.—Plans have been filed by A. Fink & Son, 810 Frelinghouse Avenue, for the erection of an addition to the engine house at its works.

PERTH AMBOY, N. J.—The Standard Underground Cable Company, 26 Washington Street, is reported to be considering the construction of a new plant in Ideal Park, on property recently acquired. The company manufactures cables, electric conduits, etc.

PHILLIPSBURG, N. J.—Improvements to the electric street-lighting system, including the installation of a number of new lighting units, are under consideration by the Town Commissioners.

POMPTON LAKES, N. J.—The Council is considering the construction of a new municipal electric power plant on Corning Lake. An ordinance authorizing an issue of $46,900 for this purpose has been adopted by the Council.

ALTOONA, PA.—Plans have been prepared for an addition, 50 ft. by 130 ft., to the plant of the Altoona Storage Battery Company, 802 Chestnut Street, to cost about $10,000.

COATESVILLE, PA.—Plans are being considered by the West Chester & Conestoga Traction Company for the construction of an electric railway from the proposed terminus, commencing at the South City line on First Avenue and extending to the iron and steel mills in the center of the town.

HAZLETON, PA.—The Cranberry Creek Coal Company is planning to equip its Cranberry mines for electrical operation by 1920. Overhead trolley wires have been abolished and the mine motors are now charged by storage batteries. The pumps will also be driven by electricity.

HAZLETON, PA.—The Lehigh Valley Coal Company contemplates equipping its entire chain of mines in the Lehigh field for electrical operation as soon as the war is over. The Oneida stope No. 4 will be equipped with electrically-driven machinery this summer. The Gowen & Wolf mines, just put into service, are equipped with electrically-operated machines and hoists.

HOLTWOOD, PA. — The Pennsylvania Water & Power Company is erecting an electric transmission line, 10 miles long, from Holtwood to a point on the Gunpowder River for the government. This line will transmit electricity to the proving grounds of the government at Aberdeen.

MANORVILLE, PA.—Work has begun on the construction of a new power house in connection with the new local plant of the Triple Airless Tire Company of Pittsburgh. The cost of the entire work is estimated at about $85,000. Herbert & Henderson of Kittanning are architects.

PHILADELPHIA, PA. — Contract has been awarded by the E. F. Benson Company, 926 North Delaware Avenue, to the William Steele & Sons Company, 32 South Fifteenth Street, for the construction of an addition to its engine plant.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 6, under specification 2923, for a motor-driven, two-stage duplex air compressor, having a capacity of 1000 cu. ft. of free air per minute at the navy yard, Philadelphia, Pa.

PHILADELPHIA, PA.—Contract has been awarded by the Badenhausen Boiler Company, 1425 Chestnut Street, Philadelphia, for the construction of a machine shop, 200 ft. by 350 ft., at its boiler works, Cornwells. The company is also planning to erect a five-story office building, 25 ft. by 175 ft., on Walnut Street, Philadelphia, to cost about $50,000.

PITTSBURGH, PA.—Contract has been awarded by the Heppenstall Forge & Knife Company, Forty-seventh and Hatfield Streets, for the erection of a new boiler plant at its works to C. Huntsman, Pittsburgh, to cost about $23,000.

SCRANTON, PA.—The Mill Creek Coal Company has recently placed a contract with the Scranton Construction Company for the installation of electrical equipment at its Morea colliery. Energy for operating the machinery in the mines and also for lighting the interior of the mines and the outside plants will be supplied by the Eastern Pennsylvania Electric Light, Heat & Power Company of Pottsville. The cost of the improvements is estimated at $200,000.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until May 10 for furnishing two 3½-ton motor trucks for use in the water department. Specifications may be obtained from the purchasing officer, Room 320, District Building, Washington.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13, under specification 2905, for power plant improvements, to cost about $35,000. Further information may be obtained from the chief of bureau.

WASHINGTON, D. C.—Bide will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 10 for furnishing, under Schedule 4298½, one generating set at the Brooklyn Navy Yard. Bids will also be received until May 6, under Schedule 4315½, for furnishing 5800 ft. single-conductor cable at Portsmouth, N. H.; Schedule 4318½, for one generating set to be delivered at Pensacola, Fla.; Schedule 4322½, for howlers, annunciators, bells and buzzers to be delivered at Detroit.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 6 for furnishing, under Schedule 4180½, electrical material, including switchboards, switches, lamps, etc. Bids will also be received, under specification No. 2879, for furnishing and installing a complete switching equipment for the control of machines in the substations and for the various incoming and outgoing feeders and all connections between panels and the machines.

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 6, under specification 2913, for an electric traveling crane in the structural shop at Norfolk, Va. The cost is estimated at $8,500.

North Central States

CINCINNATI, OHIO.—Bids will be received by the Board of Education of Cincinnati, Denton Building, until May 13 for furnishing and installing a system of electric clocks and bells in the Lincoln Public School Building. Plans and specifications are on file at 511 West Court Street.

CINCINNATI, OHIO.—All bids submitted for the installation of lighting fixtures in the new court house building have been rejected by the new court house building commission, all bids received having been too high. The lowest bid, which was submitted by the St. Louis Brass Manufacturing Company, was $62,477. The price fixed as the base figure upon which subsequent bids are to be made is $60,000. Some changes in design of the fixtures, to make them less elaborate, will be made.

HAMILTON, OHIO.—Plans are being considered for improvements to the municipal electric-light plant.

ST. PARIS, OHIO.—Bonds to the amount of $5,500 have been voted for improvements to the municipal electric-light plant.

TOLEDO, OHIO.—Press dispatches from Washington state that the War Department has announced that government nitrate plant No. 3, composed of two half units, would be located in Toledo, Ohio, and at Elizabethtown, near Cincinnati. The half unit to be erected at Toledo will be located on the outskirts of the city in the vicinity of the new Acme generating station of the Cities Service Company. The government will expend about $22,000,000 on this plant and will require a 24-hour load of 35,000 kw. of electric energy, which will be furnished by the Acme Power plant. To provide for this service a second 20,000-kw. generating unit will be installed, making the total output of the plant 40,000 kw. Financing for the installation of the new unit and the erection of the transmission line to the nitrate plant will be provided by the government. Work on the new plant, it is expected, will begin at once.

CHARLESTOWN, IND.—Bids will be received by the township of Charlestown until May 11 for the construction of a new high school building, including electrical wiring and ventilating apparatus. The cost of the building is estimated at about $36,000. Charles F. O. Pangburn is trustee.

INDIANAPOLIS, IND.—The capital stock of the Merchants' Light & Heat Company has been increased from $2,000,000 to $2,500,000.

INDIANAPOLIS, IND.—Plans are being considered by Governor Goodrich and a committee of the Legislature for the erection of one wing of a proposed building and power house for the Indiana University Medical College. The proposed building and power house will cost complete about $450,000. It is planned to expend $130,000 of the emergency and contingent fund for the erection of the first wing immediately.

MONGO, IND.—Work has been resumed on the local plant of the Farmers & Merchants' Light & Power Company.

RICHMOND, IND.—The Kilo Meter Company, it is reported, is planning to erect a plant at Richmond for the manufacture of electric meters. The company's plant at Indianapolis was recently destroyed by fire.

ATHENS, ILL.—The Athens Electric Light & Power Company has filed a petition with the Illinois Public Utilities Commission for permission to erect a high-tension transmission line over the tracks of the Chicago, Peoria & St. Louis Railroad.

HOMER, ILL.—The Homer Electric Light & Power Company has been granted a franchise to install and operate an electric-lighting system in Fairmount.

PECATONICA, ILL.—The Council contemplates the installation of an electrically operated pump at the pumping station after July 1.

MENASHA, WIS.—The City Council is considering the installation of an additional engine in the municipal electric-light and water-works plant.

MILWAUKEE, WIS.—The Universal Machinery Company, 784 Thirtieth Street, Milwaukee, has purchased a site at the north limits of West Allis, on which it is planning to establish a new plant. Tentative plans provide for the erection of a machine shop, 150 ft. by 300 ft.; foundry, 90 ft. by 160 ft.; transformer building and boiler house, 40 ft. by 60 ft., and auxiliary buildings. J. E. Purdy is secretary and treasurer.

MILWAUKEE, WIS.—Bids will be received by the board of industrial education of the city of Milwaukee, Manufacturers' Home Building, Milwaukee, until May 9 for furnishing material and construction, including electric light wiring and air line conduit work, sewer and water supply work, for the first unit of the Central Continuation School, to be erected at the corner of Seventh and Prairie Streets. Plans and specifications are on file at the above office and the office of Van Ryn & De Gelleke, architects, 726 Caswell Block, Milwaukee.

RIPON, WIS.—The Wisconsin Power, Light & Heat Company of Chicago, Ill., is reported to have purchased the property of the Ripon Light & Water Company and its branches, the Greenlake (Wis.) Electric Company, the Wisconsin Power, Light & Milling Companies at Rosendale and Eldorado, the Markesan Light & Power Company and the Kingston Electric Company. These companies, it is understood, will be consolidated under the name of the Central Wisconsin Utility Company.

WINNECONNE, WIS.—The Winnebago Electric Company of Winneconne, recently incorporated, contemplates establishing an electric plant here to supply electricity for lamps, heaters and motors. Richard W. Button is one of the incorporators.

ELDORA, IOWA.—Bids will be received by Calvin Boyland, county auditor, Eldora, until June 11 for construction of boiler house, concrete or brick smokestack, concrete tunnel, heating plant and drainage.

OTTERVILLE, MO.—The installation of an electric-lighting plant, to cost about $6,500, in Otterville, is under consideration. Jesse Straten is reported interested.

PRAIRIE HOME, MO.—The Simmons Electric Company is contemplating changing its system to 110-volt direct current, using storage battery 24-hour service, consisting of 23 Delco light units with one 160-amp.-hour, 56-cell battery. Kelly Simmons is vice-president.

JAMESTOWN, N. D.—Bids will be received by the City Council until May 6 for furnishing one double suction, two-stage volute pump with a capacity of 700 gal. per minute, against a maximum head of 120 pounds, directly connected to a 2300-volt, three-phase, 60-cycle, slip-ring motor, to be delivered on or before July 1.

MILLER, S. D.—Plans are being prepared for the reconstruction of the municipal electric-light plant and water-works system, for which $55,000 is available. The proposed plans provide for the installation of two units (directly connected), at least two boilers, rebuilding distribution system, etc. Definite plans have not yet been decided upon. William Saltmarsh is manager.

BURNS, KAN.—Bids will be received by the city of Burns until May 7 for the installation of an electric-lighting system, consisting of one 30-hp. oil engine, one 25-hp. direct-current, 110-volt generator, one 160-amp.-hour storage battery, complete pole line, etc. Archer & Stevens, New England Building, Kansas City, Mo., are engineers.

DIGHTON, KAN.—The contract for equipment, including engines, boilers, generators, switchboard, etc., for the municipal electric-light plant has been awarded to the Merkle Machinery Company. The plant heretofore has been operated by oil engines.

YATES CENTER, KAN.—The proposal to issue bonds for a municipal electric-light plant was defeated. The Yates Center Electric Light & Power Company is contemplating selling its plant. Charles H. Opperman is manager.

Southern States

COMMERCE, GA.—At an election held recently bonds to the amount of $15,000 were voted for the installation of an electric-light and power plant. Contracts, it is understood, have been placed for machinery and equipment. L. F. Brooks is superintendent.

MARYVILLE, TENN.—The Aluminum Company of America of Pittsburgh, Pa., is planning to build a plant to manufacture nitrate as a by-product of its present aluminum works and hydroelectric development, to cost about $2,000,000. Electricity to operate the plant will be transmitted from the Alcoa (Tenn.) dam, now under construction, on the Little Tennessee River, 50 miles from Knoxville.

HEADLAND, ALA.—Bonds to the amount of $10,000 have been voted for improvements to the municipal electric-light plant and water-works system.

LITTLE ROCK, ARK.—Contract has been awarded by the school board for the erection of a grade and junior high school building, to cost about $128,000, to H. F. Ault, of Little Rock. Heating and lighting systems not yet decided upon. Charles L. Thompson and Thomas Harding, 504 Southern Trust Building, Little Rock, are architects.

MONROE, LA.—Bids, it is reported, are being received by the Standard Gin Company of Monroe on cotton gin and power plant equipment. The company was recently organized with a capital stock of $60,000. John P. Parker and J. T. Austin are among the incorporators.

BLOCKER, OKLA.—The Tri-State Coal & Coke Company, recently incorporated with a capital stock of $100,000, is reported to be in the market for mining and power plant equipment. J. A. Dill is among the incorporators.

TULSA, OKLA.—The Atchison, Topeka & Santa Fe Railroad Company contemplates the erection of a passenger station at First and Second Streets, to cost about $100,000. The company will build a freight depot with terminal yards having a trackage of about 10 miles, and install an electrical interlocking system. The cost of the entire work is estimated at about $2,000,000.

YALE, OKLA.—The City Council is considering issuing $200,000 in bonds for the installation of an electric-light plant and water-works system.

BEAUMONT, TEX.—The Kansas City Southern Railroad Company is planning to install electrical equipment to operate its drawbridge across the Neches River in Beaumont.

Pacific and Mountain States

EPHRATA, WASH.—Application has been made to the Commissioners of Grant County by the Ruff Lighting Company of Ephrata for a franchise to erect and maintain electric transmission lines along the highways in Grant County. The company asks for a 50-year franchise to include the unincorporated town of Ruff.

SEATTLE, WASH.—The Skyhomish Power Company has filed with the City Council modified plans for the development of the Stillaguamish power site, submitting estimates covering proposed additional development as follows: Dam to be built at an elevation of 950 ft., with ultimate elevation of 1050 ft. With the development of the Stillaguamish stream alone, this dam would generate 66,000 hp. at an elevation of 400 ft., or 90,000 hp. with dam at 1050 ft. Building two steel penstocks for standpipe to turbine, 600 ft. long and 8 ft. in diameter, installation of two vertical units generating 30,000 hp., power house of reinforced concrete with provision for future extension to provide space for two additional units of same capacity, to change railway to go north of reservoir and join the present line at the east end of the line. The cost of the above plant, including riparian rights, is estimated at about $5,000,000. The report has been referred to the City Utilities Commission.

TACOMA, WASH.—The proposal to issue $5,000,000 in bonds for the purchase of the property of the Tacoma Railway & Power Company was defeated at an election held recently.

GOLD HILL, ORE.—The City Council has taken over, under lease, the city water system from the new owners of the defunct Rogue River Public Service Corporation, which has been operating the system under a 20-year franchise, and which expires in 1920. The arrangement is only temporary, as the city owns the McClure power plant on the Rogue River, with a 500-hp. right, which is to be developed for municipal light and water purposes. Bonds to the amount of $25,000 were voted for that purpose in 1914.

TOLEDO, ORE.—The Thorsen-Hendricksen Mill Company of Toledo, recently reorganized, it is reported, will take over and operate the local electric-light plant.

LOS ANGELES, CAL.—Plans are being prepared by the Board of Education for the construction of a machine shop, 70 ft. by 100 ft., at the San Pedro High School.

REDDING, CAL.—At an election held recently the proposal to issue $40,000 in bonds for the installation of a municipal electric-lighting system was carried.

Canada

REVELSTOKE, B. C.—The Lanark Mines Company, it is reported, contemplates the construction of a dam and power plant in Revelstoke to furnish electricity for its mine and mill. The cost is estimated at from $25,000 to $30,000. W. B. Dornberg of Spokane, Wash., is manager.

WINNIPEG, MAN.—The provisional government of Manitoba contemplates replacing the present telephone system in Winnipeg with the automatic service, at a cost of about $1,500,000. Within the next five years, it is estimated that an expenditure of $600,000 will be required for extensions to the system.

HALIFAX, N. S.—New equipment, including electric street cars, electrical equipment and generating machinery is reported to be under consideration by the Nova Scotia Tramways & Power Company. G. A. Fowler, Lower Water Street, Halifax, is engineer.

BISMARCK, ONT.—The Township Council of Gainsborough, Lincoln County, is considering utilizing Hydroelectric power.

COBALT, ONT.—The Mining Corporation of Canada is reported to be contemplating the purchase of electric motors, pumps, etc.

MONTREAL, QUE.—Extension to its carbide and electrode plants is reported to be under consideration by the Shawinigan Water & Power Company.

MONTREAL, QUE.—Tenders will soon be asked for the construction of a power house for Lamontagne, Ltd., 338 Notre Dame Street, West, to cost about $10,000. E. Laurie & Company, 243 Bleaury Street, Montreal, are architects and engineers.

GULL LAKE, SASK.—The Canadian Pacific Railway Company is contemplating the construction of a pumping station and installation of machinery at Gull Lake, to cost about $100,000. J. M. Cameron of Calgary, Alta., is manager.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until May 20 for furnishing dynamite, steel cable, copper tubing, vulcanizing material, boiler lagging, pipe covering, roll asbestos paper, etc. Blanks and further information relating to this circular (No. 1217) may be obtained at the above office or the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom, 29 South La Salle St., Chicago. Annual meeting, May 14, 1918.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary-treasurer, W. J. Tharp, Little Rock, Ark. Annual convention, Hot Springs, Ark., May 21-23.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, George C. Holberton, San Francisco, Cal.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, McKeesport, Pa. Annual convention, September, 1918.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, W. L. Connelly, Gibson, Ind.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, R. B. W. Pirie, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, September, 1918.

CALIFORNIA ASSOCIATION OF CONTRACTORS AND DEALERS. Secretary, James W. Redpath, 505 Rialto Building, San Francisco. Convention, Del Monte, Cal., May 9-11.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, M. C. Gilman, Toronto Electric Light Company.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION, N. E. L. A. Secretary, F. D. Beardslee, Union Electric Light & Power Co., St. Louis, Mo.

CONNECTICUT ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, George M. Chapman, Waterbury, Conn. Annual meeting, New Haven, Conn., May, 1918.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill. Meeting, Hot Springs, Va., May 21, 22 and 23.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert E. Elliott, 502 Flatiron Building, San Francisco.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago. Meeting, Hot Springs, Va., May 30, 31, June 1.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, L. W. W. Morrow, Norman, Okla. Annual meeting, May, 1918, Oklahoma City.

GEORGIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, Dan Carey, Atlanta Builders' Exchange, Atlanta, Ga. Annual meeting, June, 1918, Tybee Island, Ga.

ILLINOIS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. B. Van Nuys, Central Electric Co., Peoria, Ill.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, R. H. Abbott, Petersburgh, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INDIANA STATE ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, George Skillman, Indianapolis, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, David Sarnoff, City College of New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineeering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, M. T. Humphrey, Waterloo, Iowa.

IOWA SECTION, N. E. L. A. Secretary-treasurer, L. E. Caldwell, Iowa City, Iowa.

JOVIAN ORDER. Jupiter (president), Henry J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, R. M. Sutton, Wichita.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan. Annual meeting, Kansas City, Kan., Oct. 17-19, 1918.

KENTUCKY ASSOCIATION OF ELECTRICAL CONTRACTORS. Secretary, F. F. Valinoti. Annual meeting, May, 1918, Louisville, Ky.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 323 Chartres St., New Orleans, La.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Augusta, Me.

MASSACHUSETTS ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, J. E. Wilson, 263 Summer St., Boston, Mass.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Monroe, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, H. E. Young, Minneapolis General Electric Company, Minneapolis, Minn.

MINNESOTA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, G. M. Jones, 112 South Seventh St., Minneapolis, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, W. F. Wheeler, Hattiesburg.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis.

MISSOURI ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, A. J. Purns, 318 West Tenth St., Kansas City, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, H. C. Brown, 110 West 40th St., New York.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Concord, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York. Convention, Atlantic City, N. J., June 13 and 14.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill. Annual meeting, June 1, 1918.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, E. A. Thiele, Roswell.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York. Annual meeting, June, 1918.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore. Annual meeting, Sept. 11, 1918.

NORTHERN WHITE CEDAR ASSOCIATION. Secretary, N. E. Boucher, 743 Lumber Exchange, Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Convention, Cedar Point, Ohio, July 10, 11, 12.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OREGON ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, J. W. Oberender, 302 Dekun Building, Portland, Ore. Annual meeting, September, 1918.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, Crossley Building, San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PENNSYLVANIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, M. G. Sellers, 1518 Sansom St., Philadelphia.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual meeting, Evanston, Ill., June, 1918.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, Frederick D. Brown, Huron, S. D. Convention, Sioux Falls, S. D., May 15 and 16.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga. Annual meeting, June 19-20, Atlanta.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TEXAS STATE ASSOCIATION OF ELECTRICAL CONTRACTORS. Secretary, H. S. Ashley, Fort Worth, Tex. Annual meeting, Galveston, Tex., June 15, 1918.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. E. Myers, 3 Gould St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, C. H. West, Rutland, Va.

VIRGINIA STATE ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. M. Andrews, Richmond.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 W. Jackson Blvd., Chicago.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, Green Bay, Wis.

WISCONSIN ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary, J. C. Staff, 578 Jackson St., Milwaukee, Wis.

(Issued April 16, 1918.)

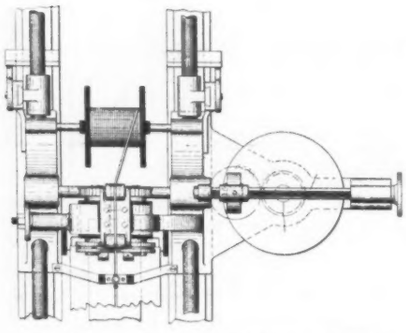
1,262,639. Telephone Exchange; Henry P. Clausen, Mount Vernon, N. Y. App. filed Sept. 14, 1917. Improvements.

1,262,645. Automatic Circuit Breaker for Coin-Controlled Telephone Systems; Herschel M. Connor and Don D. Miles, San Francisco, Cal. App. filed Feb. 20, 1917. Improvements.

1,262,648. Telegraph System; Oscar A. Danielson, Plainfield, N. J. App. filed May 2, 1917. For repeating telegraphic signals.

1,262,651. Automobile-Door Latch; Ernest S. David, Aterling, Ill. App. filed March 24, 1916. Improvements.

1,262,653. Process and Apparatus for Autogenous Welding; Pietro de Paolini, Milan, Italy. App. filed Aug. 24, 1916. Improvements.



1,262,749—Automatic Welding Machine

1,262,654. Selecting System; Amos F. Dixon, Newark, N. J. App. filed Sept. 30, 1915. For use in printing telegraph communication.

1,262,655. Selecting System; Amos F. Dixon, Newark, N. J. App. filed Sept. 30, 1915. For use in printing telegraph systems.

1,262,683. Electric Fuse; Robert A. Lewis and Edwin C. Weisgerber, Pittsburgh, Pa. App. filed Dec. 1, 1916. Detector indicates whether or not the fusible element has been blown.

1,262,692. Magneto-Electric Generator; Richard A. Oglesby, South Bend, Ind. App. filed Feb. 23, 1915. Improvements.

1,262,702. Adding Machine; Frank C. Rinsche, Detroit, Mich. App. filed July 24, 1913. Key-driven type.

1,262,704. Automobile-Lock and Ignition-System Tester; George M. Scott and Herbert H. Scott, Chicago, Ill. App. filed April 8, 1916. Improvements.

1,262,716. Signaling Device for Automobiles; Louis Thomas, Cleveland, Ohio. App. filed March 22, 1917. Improvements.

1,262,721. Contact Spring; Herbert A. Wallace, Pittsburgh, Pa. App. filed Aug. 27, 1914. Improvements.

1,262,727. Pay-Roll-Calculating Machine; Theodore D. Williams, Rochester, N. Y. App. filed Sept. 1, 1915. Small keyboard.

1,262,746. Excess Wattmeter; Alfred W. Burke, Wilmington, Del. App. filed March 2, 1915. Improvements.

1,262,747. Excess Wattmeter; Alfred W. Burke, Wilmington, Del. App. filed Dec. 4, 1915. Automatically corrects the error in wattmeters.

1,262,749. Automatic Welding Machine; William J. Callahan, Garwood, and Joseph W. Raynor, Plainfield, N. J. App. filed Oct. 10, 1913. For automatically welding articles together by means of an electric arc drawn between a metallic electrode and the articles to be welded.

1,262,752. Telephone System; Henry P. Clausen, Mount Vernon, N. Y. App. filed April 26, 1917. Improvements.

1,262,774. Dynamo-Electric Machine; Ralph E. Gilman, Pittsburgh, Pa. App. filed Oct. 3, 1914. Damper windings.

1,262,784. Insulating Support; Arthur J. Hall, Wilkinsburg, Pa. App. filed June 8, 1917. Improvement.

1,262,802. Lamp Support; George T. Irwin, Toronto, Ontario, Canada. App. filed Dec. 2, 1915. Improvements.

1,262,805. Auxiliary Signal; Harry L. Kaser, Canton, Ohio. App. filed Oct. 28, 1916. Improvements.

Record of Electrical Patents

Notes on United States Patents

1,262,824. Speed Control for Induction Motors; Frederick W. Meyer, Pittsburgh, Pa. App. filed June 20, 1914. Speed may be controlled throughout a wide range.

1,262,831. Elevator Safety Device; George Nissenson, New York, N. Y. App. filed Oct. 8, 1915. For controlling and starting a water, steam or otherwise operated elevator machine.

1,262,838. Electromagnetic Apparatus; Frederick P. Poole, La. Grange, Ill. App. filed April 11, 1917. Energizing winding may be accurately located and positively secured in definite relation to the end of its core.

1,262,843. Automatic Telephone System; Arthur J. Ray, Chicago, Ill. App. filed June 16, 1913. Improved means for handling long-distance calls.

1,262,861. Secondary Fuse Block; Andrew F. Sproul, Oakland, Cal. App. filed Jan. 29, 1917. Cheaply constructed device which is positive in action and may be easily repaired.

1,262,895. Electromagnetic Control Switch; George S. Wood, New York, N. Y. App. filed May 3, 1917. Improvements.

1,262,912. Means for Preventing Disturbances in Substation Telephone Sets. App. filed Dec. 22, 1916. Improvements.

1,262,914. System of Distribution; Joseph Bijur, New York, N. Y. App. filed Dec. 21, 1910. For electric lighting of railway vehicles.

1,262,916. Controlling Device for Self-Focusing Electric-Arc Lamps; John L. Boyle, Boston, Mass. App. filed Jan. 13, 1913. Arc automatically maintained at a predetermined point.

1,262,917. Regulator for Charging Storage Batteries; Stephen F. Briggs, Milwaukee, Wis. App. filed Feb. 12, 1915. Improvements.

1,262,936. Electric Lamp; Frank L. Fowler, Philadelphia, Pa. App. filed June 17, 1916. Interlocks the lamp bulb with its base.

1,262,964. Portable Lamp; Harrison D. McFaddin, East Orange, N. J. App. filed March 12, 1915. Clamping mechanism for detachably securing a lamp to the arm of a chair, bedpost or other support; an improved shadeholder which permits of the shade being readily tilted or adjusted as desired.

1,262,969. Key Socket; Harry J. Morey, Syracuse, N. Y. App. filed Aug. 3, 1916. Fixed and moving parts of the device are held on the single-piece porcelain base.

1,262,988. Switch Box; Clarence M. Sieffert, Evansville, Ind. App. filed Dec. 5, 1916. Improvements.

1,263,005. Low-Tension Spark Plug. App. filed Sept. 21, 1916. For internal combustion engines.

1,263,010. Semi-Automatic Telephone System; Bernard D. Willis, Chicago, Ill. App. filed Oct. 14, 1913. Improved trunking arrangement.

1,263,013. Telephone Meter-Service System; George A. Yanochowski, Chicago, Ill. App. filed Sept. 2, 1915. Improvements.

1,263,021. Heating Device; Alexander Bender, Chicago, Ill. App. filed Feb. 11, 1918. Structure to which an electrical iron can be readily secured and which has radiating walls for throwing off into the room the heat received from the iron.

1,263,028. Section Insulator and Switch; Newton K. Bowman, Canton, Ohio. App. filed March 9, 1917. Insures perfect insulation of the sections when the switch is open and perfect contact when the switch is closed.

1,263,039. Electrical Resistance; John G. Clemens, Buffalo, N. Y. App. filed Sept. 25, 1917. Resistance to passage of current will gradually decrease as it becomes heated.

1,263,050. Connecting Device with Insulators; Arthur H. Fargo, Wilmington, Del. App. filed April 4, 1914. Adapted to be connected to a ground pipe.

1,263,069. Telephone-Exchange System; Charles W. Keckler, Newark, N. Y. App. filed July 12, 1917. Impossible to establish a connection between two telephone lines using portions of two connecting circuits.

1,263,073. Signaling Device; August J. Kaloneck, New York, N. Y. App. filed Jan. 28, 1914. For producing high-frequency electrical currents.

1,263,078. Induction Motor; Justin Lebovici, Oakley, Ohio. App. filed May 14, 1917. Secondary windings adapted for reconnection after starting.

1,263,083. Telephone-Exchange System; Alben E. Lundell, New York, N. Y. App. filed Aug. 16, 1916. A line in trouble may be cared for.

1,263,140. Telephone Transmitter; Lonnie B. Stone, Louisville, Ky. App. filed April 4, 1914. Improvements.

1,263,150. Reciprocating Safety Switch; Horatio S. Tittle, San Francisco, Cal. App. filed Nov. 27, 1916. For delivering a current to the apparatus to be started without the current passing through the fuses during the starting period.

1,263,181. Electric Stove; Stover C. Winger, Los Angeles, Cal. App. filed Dec. 11, 1917. Simple means for regulating the heat.

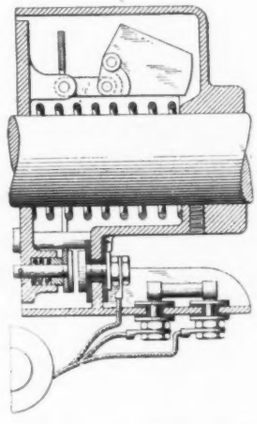
1,263,190. Thermostatic Circuit Closer; Albert I. Bennett, Fort Atkinson, Wis. App. filed April 14, 1917. Electric automatic fire alarm.

1,263,204. Apparatus for Receiving Electrical Oscillations; Elmer E. Butcher, Interlaken, N. J. App. filed May 14, 1914. Improvements.

1,263,247. Electric Contact Device; Gottlob Honold, Stuttgart, Germany. App. filed July 21, 1917. Mechanically controlled interrupter for use with the ignition devices of internal-combustion motors.

1,263,280. Speed Alarm for Autovehicles; Peter E. Paulson, Eastedge, N. D. App. filed April 20, 1915. Means for sounding a bell alarm when the speed limit is exceeded.

1,263,292. Bias-Fabric Assembling Table; William C. Stevens, Akron, Ohio. App. filed May 20, 1916. Improvements.



1,263,078—Induction Motor

1,263,308. Measuring Apparatus; William H. Bristol, Waterbury, Conn. App. filed June 22, 1917. Single pointer operates over a chart to produce a multiplicity of records of separate and distinct operations.

1,263,314. Apparatus for Electrolysis; Philip A. Emanuel, Aiken, S. C. App. filed Dec. 24, 1917. Improvements.

1,263,344. Electric Switch; Carl Bramming, Chicago, Ill. App. filed Feb. 19, 1917. Single and compact device.

1,263,350. Electric Heater; George J. Schneider, Detroit, Mich. App. filed Dec. 31, 1908. Improvements.

1,263,351. Electric Heater; George J. Schneider, Detroit, Mich. App. filed Dec. 31, 1908. Improvement.